EXHIBIT L

UNITED STATES DISTRICT COURT
WESTERN DISTRICT OF NEW YORK
Civ. No. 1:21-cv-00704-JLS
--X

CAROL S. MARCELLIN,
Individually, and as
CoAdministrator of the
Estate of Charles E.
Hollowell, deceased, and
JESSICA HOLLOWELL-McKAY, as
Co-Administrator of the
Estate of Charles E.
Hollowell, Deceased,

Plaintiffs,

-against-

HP, INC., and STAPLES,
INC.,
Defendants.
--X

DATE: April 3, 2025
TIME: 10:06 a.m.

EXAMINATION BEFORE TRIAL of the Expert, QUINN HORN, taken by the Plaintiff, pursuant to a Court Order, held via Zoom, before a Notary Public of the State of New York.

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A P P E A R A N C E S:

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ALSO PRESENT:
Jessica McKay
Marcelo Rivera, Videographer

* * *

S T I P U L A T I O N S

IT IS HEREBY STIPULATED AND AGREED by and between the parties hereto, through their respective counsel, that the certification, sealing and filing of the within examination will be and the same are hereby waived;

IT IS HEREBY STIPULATED AND AGREED that all objections, except as to the form of question, will be reserved to the time of trial;

IT IS HEREBY STIPULATED AND AGREED that the within examination may be signed before any Notary Public with the same force and effect as if signed and sworn to before this Court.

THE VIDEOGRAPHER: Good morning. We're going on the record at 10:06 a.m. on April 3, 2025.

Please note that this deposition is being conducted virtually. Quality of recording depends on the quality of camera and internet connections of participants. What is seen from the witness and heard on screen is what will be recorded. Audio and video recording will continue to take place unless all parties agree to go off the record.

This is Media Unit 1 of the vide-recorded deposition of Dr. Quinn Horn, in the matter, Marcellin versus HP, Inc. and Staples, filed in the United States District Court for the Western District of New York.

This deposition is being conducted remotely using virtual technology. My name is Marcelo Rivera, representing Veritext Legal Solutions and I am the videographer. The court reporter is Alexis Zinckgraf

in association with Veritext Legal Solutions.

I am not related to any party in this action, nor am I financially interested in the outcome. All present counsel will be on the stenographic record.

Will the court reporter please swear in the witness?

Q U I N N H O R N, called as a witness, having been first duly sworn by a Notary Public of the State of New York, was examined and testified as follows:

DIRECT EXAMINATION BY MR. SCHWARZ:

Q. Good morning, Dr. Horn.
A. Good morning.
Q. My name is Steve Schwarz. I am one of the attorneys representing the plaintiffs in this case, and I will be asking you the questions today.

From looking at your materials

that you provided, I would believe that you've been through this process before, correct?

A. The deposition process, yes. I have gone -- yes.

Q. So I'm not going to bore you with all the details, and if we talk over each other, we can remind each other not to do that, but other than that, I won't go through the -- the spiel that I'm sure you've been through a hundred times.

Did you receive the -- the binder that we sent?

A. I -- I did and --

Q. Okay.

A. -- it's unopened. It's here.

Q. Okay. Thank you for verifying that, and you can open it now, if -- if you would, sir. I probably should have told you that 20 minutes ago, but I forgot.

MS. WANEMAKER: Okay. Steve, would you like to put something on the record with respect to usual stipulations?

MR. Schwarz: Sure. In fact,

yes.

Alexis, we are stipulating that the -- you can keep opening, Doctor, that any objections are reserved for trial except for objections to the form of the question, which have to be raised or waived, and the witness will choose to read and sign, I believe, right, Jackie?

MS. WANEMAKER: Correct. Thank you.

MR. SCHWARZ: Okay.

A. Okay. So I have removed it and that's what it says.

Q. Okay. Great. So --

A. Appears to --

Q. There are numerical tabs, and if you could turn to the first tab, that's what I have marked as Exhibit 1, and it's your report with the appendixes to your report that are attached to it.

(Exhibit 1, Report, was received and marked for identification by the reporter.)

A. Okay.

Q. And I'd like to just start with some of the information from Appendix B, which is your CV.

A. It's okay. If you can just give me just a second, several of the pages are not in the rings. So I need to do a -- just a little bit of engineering on the binder, engineering, if you will, just to get that --

Q. You go ahead and do that, so they don't all fall over the place.

A. Exactly. Okay. Thank you for that. And okay. So I'm sorry. You would like me to go to which -- which page?

Q. Your Appendix B, which is your CV.

A. Sure. Okay.

Q. So my understanding from looking at it is that you -- your educational background, your highest level was a PhD in Metallurgical and Materials Engineering that you got in 1998, correct?

A. Correct.

Q. And then your first employment after getting your PhD was with?

Eveready Batteries; is that correct?
A. Energizer/Eveready Battery Company, yes.
Q. And can you tell us -- it says you were a staff technology engineer, what was the -- the nature of your work there for those four years, from '98 to 2002?
A. Yeah, absolutely. The -- so the -- as -- as a metallur [sic], just -- I was actually replacing the corporate metallur, just -- Energizer/Eveready at the time, in the late 90s, was the largest battery company in the world.
They had one metallur just on staff, he was retiring. I happened to be graduating with a metallurgical engineering background with some knowledge of batteries and so it was a great fit. So I replaced the corporate metallur, who was retiring and took over what was called the Materials and Characterization Group, which was the home for a number of things, assisting R&D with materials, characterization, and also doing corporate failure analysis on manufacturing and battery products.

So I led a team for -- to do all of that. So my group had sort of all of the character -- materials, characterization tools necessary for doing high-end research and development, as well as doing failure analysis of product that was being manufactured at the time. So field failures, as well as failures that were occurring in manufacturing facilities and things of that nature.

Q. Was Eveready/Energizer [sic] at the time manufacturing rechargeable lithium ion batteries?

A. They were. When I first started in 1998, they had a facility in Gainesville, Gainesville, Florida, and that was a facility where they were manufacturing 18650 lithium ion cells. So they -- the were -- they were ramping up.

So they were manufacturing 18650 lithium cells with the intent to commercialize those cells. They ended up selling that plant, I believe in 2000 or 2001, I -- I forget exactly which year, and got out of the lithium ion business, but

at the time, I was working with the Gainesville folks, helping them solve problems, again, with manufacturing and failure problems with the -- with the batteries and so forth.

Q. So let's just dive into that a little bit more. So are you saying that -- that Eveready/Energizer never actually commercially sold lithium ion batteries, they sold the plant before the plant got to the point of producing commercial batteries?

A. Correct.

Q. And so whatever you were doing with regard to that plant was related to the startup of the manufacturing process and assisting them in their -- making sure the products were -- were meeting specifications?

A. Correct.

Q. Were you involved in designing those lithium ion batteries in any way?

A. To the extent of looking at -- characterizing material -- materials' parameters and materials' properties of the active material and associated materials

that were going into the batteries, absolutely.

Q. So the -- the -- so the battery chemistry, so to speak, was something that you were involved with?

A. Yes.

Q. And in your report, you go through the -- some of the basics of how those batteries are constructed, so we'll -- we may look at that later.

With regard to the -- the manufacturing process then and what you were doing, did you do any studies of -- of failures from the standpoint of energetic failures of those batteries?

A. Yes.

Q. And tell me about that. What -- what types of studies did you do of energetic failures of lithium ion batteries during those two years that that plant was there and you were there?

A. So, you know, I mean, you know, obviously, you know, at the time, field failures were not -- in lithium ion batteries were not a huge concern at the

time in the industry. Although, there were -- the industry was starting to see some, but, you know, the -- the idea was that they really wanted a battery that was safer than lithium prime -- most of the lithium primary batteries.

Those are non-rechargeable lithium batteries, and so the -- the types of things that -- that you would be concerned about would be things like overheating, venting of -- of hot, or caustic, or toxic gases, venting of gases that could be potentially flammable, you know, how to prevent that, how to minimize that, how to control that, how to design a cell in case it does have a, you know, there's an internal defect, or it's misused, or abused in some way, you know, how to test for that.

So, you know, a lot of, you know, external heating-type tests, a lot of intentional defect tests, where you manufacture the battery with intentionally placed defects that you can then activate later to simulate maybe an internal short

circuit or something like that. Physical abuse tests.

At the time, nail penetration tests were very, very common in the industry, because of some of the Japanese standards that were -- that were in place. So a lot of nail penetration tests. A lot of what we called in the day, hot box tests.

They're mostly called oven tests now, but guys that have been around long -- as long as I have, often refer to them as hot box tests, but basically, you know, heating the cells up in ovens and -- and looking at what temperatures they will have thermal events, and basically, starting to build a foundation for understanding, you know, how lithium ion batteries, you know, fail under different conditions.

Q. So that was a mouthful. So let me kind of break that down. So you directly conducted empirical testing of lithium ion batteries for -- for instance, overheating and thermal events?

A. Correct.

Q. And where did that testing take

place?
A. That testing took place in West Lake, Ohio, in some of the old -- old labs that were used for lithium cobalt oxide testing in the --
Q. In what -- go ahead, I'm sorry.
A. No. That's -- that's fine.
Q. Now, the -- the lithium ion battery chemistries from the 1998 to 2000 time period, there's been an evolution of those batteries over time, correct?
A. There's been an evolution in the -- in the technology -- I mean, so yeah. Yes, there has been. There have been significant improvements in the -- in the materials and performance in -- of the cells.
Q. So a lot of those -- the battery cells from that year -- or for instance, could not go through as many cycles as the battery cells that they sell today of the 18650? They have a longer lifespan?
A. I would -- no, I would disagree with that. At the time I was working at Energizer, the goal was to get a thousand

cycles on -- on -- on a cell to 80 percent capacity. That was seen as, you know, at the time, the industry standard. The industry standard has now come down to about 300 cycles to 80-percent capacity for consumer electronics.

I think the biggest improvement has been energy density, as well as power density for applications that require very high power, like power tools and things of that nature. So there -- there -- if you -- and cost. The cost of the -- of the batteries has -- has dropped significantly since that timeframe.

Cycle life has really not actually improved surprisingly that -- that much. Most of the improvements have been in the -- in the energy density and -- and for specific applications, power density, and cost.

Q. Just so I understand, if you -- if you improve power density, does that also improve the -- the length of time before you have to recharge?

A. No. Power density is -- a power

is how fast you can discharge the battery, and energy is how much total energy the battery stores.

Q. So the more energy the battery stores, the -- the less frequently you'd have to recharge?

A. For a -- for a -- for a low-power application, correct.

Q. Would a laptop be a low-power application?

A. A laptop is a low power, high-energy application.

Q. So for a laptop, 18650 batteries, is it true then that -- that they've improved with regard to the length of time they'll run without being needed to be recharged since 2000?

A. The -- given the same power drain on, you know, load on the battery, yes. The energy -- what we can call the energy density of the battery has increased. So the amount of capacity and voltage of the battery has increased since, you know, the -- the late 90s, early 2000s.

Q. Were you in any way involved

with battery management systems, as well as the cells themselves?

A. Only in so far as understanding what the battery management systems do, you know, as, you know, you know, controlling overcharge, controlling overdischarge, balancing circuits and things like that.

Understanding what they do, but not in the design of a battery management system. I'm not an electrical engineer. So I understand what they do, I understand what battery management systems need to do in order to keep the cells happy in the battery pack, but again, I'm -- I'm not an electrical engineer.

Q. So let me just make sure I understand from a timeframe standpoint. What I was asking you specifically was: During your time at Eveready, during the time that that plant for the lithium ion batteries were ramping up, was -- were you involved in assessing how battery management systems would work with cells?

A. I was part of a team of -- of people that were looking at what was going

to be required in a battery management system for -- given for certain applications, you know, so, you know, did you need overdischarge protection, did you need overcharge protection, do you want or need balancing, do you need over-temperature protection, do you need under-temperature, those types of things.

So I would provide input as far as for a given application, what the cells would like, because lithium ion cells do like to be operated in -- in a certain, you know, comfortable voltage temperature window regime, as well as charge rate and discharge rate.

So -- so I would be part of the team that would be informing the electronic side of the group that would be designing the battery management units and telling them what we felt would be, you know, from a cell level perspective, what would be important for the battery management unit or the battery management system.

Q. I can look up the name of it, but see if I can find it quickly. Was the

smart battery data specification in place at the time you were doing that work?

A. I -- I -- I -- I -- I -- I'm familiar with the smart battery specification system. I -- I don't recall if it was -- if it was in place at -- at the time or not.

Q. Was -- was Eveready/Energizer planning to -- to manufacture the entire battery packs as opposed to just battery cells at that point?

A. The intent was to do both.

Q. Okay. And so you weren't involved in the battery management pack -- battery management system design, but you were one of the people that informed that team of the different -- the different safety mechanisms that would be required?

A. Correct.

Q. Okay. And you mentioned a few of them, but over-temperature, overcharge, cell balance, overvoltage would be some of those -- overdischarge, right?

A. Correct.

Q. And was the -- the -- your

understanding then that the battery management system was to provide those protections in the circuit board that would be part of a battery pack?

A. Yes. It was -- it was understood at that point in time. With lithium ion batteries being first commercialized in the early 1990s, by 1998, 1999, it was definitely understood in the industry that to get, you know, to maximize the lifetime of the battery, you know, when I say "lifetime," not, you know, how long it takes before you have to charge it again, but how long the battery will last, and, you know, in -- in a certain application, you know, how many cycles or how many years.

One needs to make sure that they treat the battery in a way that minimizes site reactions and things like that. Keep the battery happy is what the -- the BMS is designed to do. Keep the -- keep the battery cell happy.

Q. Well, in addition to that, it was also recognized by -- at least that time, by the time you got your PhD, that

these batteries also had a -- a safety risk if they got to conditions that were overcharged, over-temperature that could result in a runaway reaction that's called thermal runaway, correct?

A. Yeah, that was -- that was -- at the time, it was recognized that there -- there were -- there were potential issues. It was not well-understood, the mechanisms at the time, but it was beginning to be understood.

So there were, you know, some of the seminal papers were being published in the late 90s on -- on -- on safety on -- there's a lot of confusion back then, because there was a lot of lithium -- lithium metal rechargeable, lithium batteries, and a lot of inter -- the -- the nomenclature had yet to be really standardized at the time, but -- but yes.

I mean, it was -- there -- there -- I believe in -- I believe it was '96 or '97, the first big consumer battery failures sort of hit the market and that was in -- with -- when Apple introduced a laptop with

the first ever lithium ion -- first ever lithium ion battery-powered laptop computer, and they had some safety issues, and that was -- that was probably in '96, '97, I think, and that was sort of when the industry really kind of started to, like, key in, and say, all right, we don't really have standards for this.

There were really no industry standards or guidelines for -- for -- for -- for the usage of batteries at the time. There was a lot of finger-pointing in the industry at the time as well. There was a lot of -- so, you know, the laptop, computer companies would point the finger at the battery pack companies, and the battery pack companies would point the finger at the cell manufacturers.

So eventually, they all got together in the early 2000s and formulated some guidelines, and then they -- they -- about ten years later, they -- they revamped those and improved those for how one designs batteries for notebook computer applications, but back in the late 90s,

there weren't a lot of industry guidelines at that point.

Q. When you say "batteries," you're also referring to battery management systems, correct?

A. So yes, and that's a very excellent question. I want to, you know, even I am guilty of using the word "battery" and "cell" synonymously. So technically speaking, a battery is one or more cells with -- when we're talking about lithium ion, a battery is one or more cells with some type of electronics in it.

So in -- in your cell phone, your cellular phone, your mobile phone, it has one lithium ion cell with a BMS unit, and that one cell with the BMS is called the battery. In your notebook computer, typically, you have more than one cell. In case of this instance, you've got six cells with a, you know, in a, you know, battery pack with a BMS. So that's your battery.

At any point, if I -- if I, you know, please forgive me, because I will use the word "battery" to talk about a cell

sometimes. I really work hard not to, but I might. Feel free to correct me.

Q. No, I apologize. I appreciate that, actually, and I appreciate you defining the terms so that we use the right terms, because I want to make sure we're both communicating with the same terms.

During the --

A. And just to make sure that we're -- we're all on the same page, you know, what normally gets everybody on the right track is when I say, when you go to your local grocery store and you buy a pack of Double As off the -- off the pogo pin stand, you know, each of those Double As is -- we call them batteries, but they're actually cells, right?

It's -- it's just chemistry in a can with no electronics wrapped around it. That is technically a cell. So, you know, when we're talking about in this particular case, we've got 18650s, those are lithium ion cells of a certain size. Just like a Double A battery is a alkaline cell of a certain size, so --

Q. Okay. Great. So going back to your time then at Eveready/Energizer when you were working with lithium ion batteries, did you do research specifically of attempting to provoke cells to go into thermal runaway and study thermal runaway reactions once those cells went into that -- that mode?

A. Yes. There -- there -- there was -- I mean, I was part of, you know, there's always teams of people. People don't go, you know, go off into, you know, a vacuum and do -- and do things on their own, typically, in the industry.

There's always a team of people, but yes. I mean, I was definitely part of the -- the team that was doing things like looking at, you know, how hot do you have to get the battery before it -- it becomes a safety risk, you know, how hot do you have to get the battery before it starts to maybe, you know, just have performance degradation, right, you know.

Q. Let me -- let me just stop you a minute, because I really want to focus on

the thermal runaway part of it, and I know that there were many other reasons you attest and many other conditions you want to look out for, but with regard to thermal runaway itself, in other words, just seeing what temperature -- what external temperature you would have to reach in order to have the battery cells go into -- or the cells go into thermal runaway, did you actually participate in those studies, you -- hands-on involved with the -- the actual data collection?

A. Yeah. I mean, some of that was done in -- in Gainesville, Florida, where I -- where I would -- I did -- I did go, and then some of that was done at -- in the West Lake facility, where -- and it was basically an extension of the lithium primary work that had been being -- had been ongoing at Energizer/Eveready for, you know, since the early 80s, and lithium primary batteries, you run into the same issues.

There's thermal runaway events there as well. So it's basically using the same facilities, the same techniques, the

same ovens, the same, you know, furnaces to -- that were being done in the 80s and early 90s, and -- and even when I was there on lithium primary to, you know, basically, use that same technology and the same knowledge base for looking at lithium ions.

Q. So did you design experiments then to provoke the runaway in these cells?

A. I was part of the teams that would look at how we should be doing those tests -- how we should be doing those tests, yes.

Q. Okay. So tell me the -- the test that you were personally involved with -- and did you publish anything from -- from any of those studies?

A. I did not. Whether or not anybody at Energizer did, I can't speak to that.

Q. Okay.

A. My -- My guess would be no, because there, you know, again, around 2000 or 2001, there was a business decision made at a much higher level than I was. The company was going to get out of the lithium

ion battery business, and after that, the focus was put on lithium primary batteries in -- on the nonaqueous chemistry side of things. So --

Q. In the -- in the experiments then that you were involved with, that you were hands-on involved with, tell me how the -- the methodology that was used to keep the battery and how the temperature of the battery was measured to determine at what level or what -- what temperature the thermal runaway reaction would start.

A. So basically, three different types of -- of heating methods were employed, and quite frankly, are -- are still employed, you know, again, a lot of this stems from work that was done on lithium primary in the -- in the 80s.

So you've got -- in no particular order, you -- you -- you have, you know, you're aware of, you know, there's basically three different types of heat transfer, right?

There -- there's -- there's conductive, which is where you -- you

transfer heat through the contact of a hot surface with a surface that is at a lower temperature, that's conductive. You have convective, which is heat transfer through air or -- or a gas, and then you have radiant -- radiation, which -- radiant heat, which is heat that's transferred through -- in -- basically, through infrared radiation to -- to a -- to a sample.

So essentially, basically, what we're doing is looking at three -- those three types of -- of ways of doing it. So conductive is -- generally, you can put the battery on a hot surface where it's in contact with a hot surface or you could -- you could put the battery into, you know, we're talking about cylindrical batteries, mostly at the time.

So you could put the battery into a -- a form-fitting, like, a pipe that's just a little bit bigger inter-diameter than the battery is itself and then heat the pipe up, so that the pipe is then conducting the heat into the battery.

You can do convective, which is essentially putting a battery in an oven where it has minimal contact to hot surfaces and does not have a direct line of sight to a heating element. So the air is heating the battery up, or you can have radiant, where the battery is in the direct line of sight of a heating element that is then heating the battery directly. So those are -- I mean, whenever you're doing battery thermal testing, those are essentially the three different categories of heating that one would look at for -- for -- for doing it.

Now, there's sort of a little bit of a side category, which would be direct exposure to a flame. So UL1642 has a test -- standard -- has a -- what's called a projectile test, where the battery is exposed to a flame, directly exposed to -- a flame is impinging on the cell itself.

So in that particular case, there's a combination of convective and radiant -- radiation heat. So that's sort of a combination condition, where you may

have a combination of two factors, but those -- that's pretty much your -- your -- your three primary categories, and then you may have something like a flame impingement, which may combine, you know, you know, more than one type of heat transfer mode.

Q. When you were at Eveready/Energizer, did you use all of those methods in heating batteries to -- to provoke them into thermal runaway?

A. Yes, we -- we did. I mean, I can distinctly remember doing conductive testing, doing oven testing, doing radiant heat testing, as well as doing flame impingement testing, yes.

Q. So my understanding of what you said is for the radiant heating method, you want to make sure that the -- there's a direct line of sight from the source of the radiant heat directly to the cell, correct?

A. Correct. I mean, you know, with -- basically, you know, radiant heat is -- is infrared radiation, which is essentially light that we can't see, and so that is, you know, in order to heat the sample, it can't

be shaded, right?

It's a direct line of sight heat transfer mechanism. You can't, you know, I mean, unless -- unless -- unless you're using radiant heat to heat something else, which then heats your sample through either conductive or --

Q. That's -- that's not what I was asking. I wanted to -- so the direct radiant heat, the key is to have a direct line of sight, so to speak, between the radiant, the IR source, and the battery cell itself?

A. So basically, if you're doing raw -- raw cell testing, if you're doing battery pack testing or if you're doing testing of the batteries in a device, then the cells may not be exposed to direct radiant heat.

They -- they would then be, you know, the outer-casing may be exposed and then that heat would be convected to -- or conducted in -- in the -- depending on the type of heating that is employed to the batteries.

Q. So that's what I was going to get at. So the -- in my experience, looking -- learning a little bit about these battery cells and not even anywhere near as much as you know, I know that when they're sold commercially, typically, the -- the battery cells themselves are -- are wrapped in a plastic-type coating, and then typically, the battery packs that are actually inserted into devices like laptops are then enclosed in a hard plastic cell.

Is that something you're familiar with?

A. So the batteries are just to make sure the -- I believe -- I believe I am familiar with that. I just want to put it in -- in different terms that --

Q. And you might use a better term than "plastic."

A. No. I -- I -- I think that you're fine with that. The battery cells are generally -- when we're talking about 18650 cells, they are generally, you know, shrinkwrapped in a, you know, shrink-wrap is a plastic that, you know, it's basically a

thin plastic tube that you put around the -- the battery cell, heat that up, and it shrinks and it sort of wraps around the -- the battery, and it provides -- and it's a -- it is actually a safety component of the safety of the battery, because it prevents short-circuiting from the positive terminal to the can when used correctly.

So that's your first -- that's your first plastic layer. That's a -- it's a very thin plastic that goes around the cell. So typically, when you're looking at battery cells, you don't see just a steel can, right? It's got some kind of wrap around it, and then generally, most people never lay eyes on an 18650 battery cell even though they use them on a day-to-day basis, because they are in a battery pack.

You're not going to go to Walmart and buy an 18650 cell. They're generally only sold by cell suppliers to be incorporated into a battery pack of some kind. That battery pack may be plastic, as in the case in this instance. It could be other materials, but it's generally in some

sort of -- of a pack.

Q. So when -- when you were involved with the direct testing of the 18650 cells and you used the radiant heat source, did you typically put the -- the bare metal can cells in line with the radiant heat source, or did you just typically put them into a battery pack situation with the shrink-wrap and then with the hard plastic around it, or did you do both?

A. Again, you know, we're -- we're talking 25, 24 years ago, but I mean, I recall that we were doing both cells and -- and packs for -- we had -- Energizer had some specific customers lined up for -- for -- for their cells and battery packs, and so we were looking at both -- both cells and as well as some prototype packs at -- at the time.

So I believe that both cells and packs were being done, yeah. I'm pretty sure we were doing heat -- I'm pretty sure we were doing thermal testing on both -- on both cells and battery packs. That, I'm

fairly confident of.

Exactly what tests were being -- we were doing -- and we were -- and with respect to the cells, most of the testing was done on cells, but prototype packs, we were definitely doing testing on prototype packs as well. I just don't recall the details on exactly what -- what heat transfer mechanisms we were -- we were looking at.

Q. So would it be a fair statement, though, that -- that the amount of radiant heat that would be required to get a -- a battery -- a lithium ion battery cell without its plastic wrapping to a temperature that would provoke thermal runaway, it would take more heat if you had the insulation material of the plastic around it to get to that same temperature?

A. I don't think that would be a -- I don't think that would be a fair statement. Maybe --

Q. You think that -- that having something --

A. Hold on --

Q. Let me just restate it. So what you're saying, I think, if I understand, is that the plastic wrapping and the plastic would have no impact on the radiant heat transfer from the radiant heat source to the battery cell. The -- the radiant heat would not absorb any -- the plastic wouldn't absorb any of that radiant heat, it would all go to the cell.

Is that what your test showed?

MS. WANEMAKER: Object to the form.

You can answer.

A. You know, you're asking me some pretty specific questions about some testing that I did, you know, was involved with a -- a very long time ago.

Q. Okay. Well --

A. And --

Q. You're a materials expert, right? I mean, you know materials, correct?

A. I -- I -- I am -- I will tell you that I am a -- I am here as a battery failure analysis expert, and to the extent that you really want detailed analysis on

thermal conduction, and thermal conductivity, and heat transport, that would -- those would be great questions to direct to fire cause and origin folks.

I will tell you this, and this is what I know, that when you are looking at -- especially when you're looking at radiant heat transfer, radiant heat transfer is significantly affected by the surface condition of the sample that you have.

So let's say you have a -- a battery cell in a can that has no plastic around it. A lot of the radiant heat is going to be -- can be reflected off of that surface.

So it actually -- for the same amount of radiant heat on that surface versus as -- versus if you put a black plastic wrapper around it, which would absorb more of that heat, as opposed to reflect that heat back, you could -- for the exact same heat flux, you could definitely heat a cell up faster with a plastic around it that absorbed the heat, versus having the cell just exposed with either no plastic on

it and a reflective metal surface or a plastic that did not absorb the IR as much as, say another -- another plastic.

So it depends on how much of the IR that's being put into the sample is being absorbed by the sample versus how much is being reflected, and that is a function of the surface conditions, as well as the surface materials. That's basically the extent of what I know, and I don't talk about any of that in my report, so --

Q. I would beg to differ. I think you do, but we'll talk -- we'll show you why.

With regard to what you're saying, though, if I understand it correctly, you don't have any experience in how the plastic wrapping and the plastic case of the battery management pack would impact the efficiency of radiant heat to heat battery cells, you're saying that's not in your line of work or not your specialty?

A. I mean, I'm going to say that -- that it will have an impact, absolutely.

Q. What will have an impact?

A. That, you know -- the -- I mean, doing radiant heat on a battery cell that has no plastic wrapped around it -- around it versus the same cell in a battery pack that has material around it. Yeah. I mean, the material will have an impact, whether it -- whether it makes it -- heats the cell up slower or heats the cell up faster, is going to depend on the materials.

Q. And for the typical materials that were used for battery packs, for laptop computers, and I think in your -- in your report, you had actually gotten a exemplar battery pack for this type of computer that you looked at, right?

A. Yeah. An HP exemplar, yes.

Q. Yeah. And so, you know --

A. So I want to make sure we didn't get -- we didn't get a non-OME exemplar. We --

Q. Right. An HP exemplar.

A. An HP exemplar, yes.

Q. One that -- that -- that looked like the other one, but wasn't -- wasn't identical to it, because the other one

wasn't a exemplar, correct?
A. You're talking the "other one" being the instant?
Q. Yes.
A. Yes.
Q. The one that was in the computer.
A. Correct, correct.
Q. So that had a black, hard plastic coating that was -- that contained the entire battery pack, and then the individual cells were -- were shrinkwrapped, as you described in your exemplar, correct?
A. That is correct. That's --
Q. And is it your opinion then that having that heavy plastic casing for the battery pack and the shrink-wrap would somehow enhance the ability of radiant heat to get through that plastic and heat the battery cells faster than if you just took a metal cell and put it in front of a radiant heat source?
A. It -- it -- it may, yes. I mean, that --
Q. Do you have any -- any data that

-- in other words, have you seen any studies or have you done any studies that would show that -- that having all that plastic around it would somehow speed up the reaction of -- of heating up the battery cell?

Is there -- can you tell me, like, where you get that -- that evidence?

A. I think that's basic heat -- that's basic heat transfer. It could -- again, it could -- it could heat it up, or it could speed it up, or it could slow it down.

So basically, it's -- it's about how much of -- so you have a certain heat flux going into the surface of the sample. How much of that heat is absorbed by the sample and how much thermal mass is the plastic contributing. If the plastic absorbs more heat than what it's contributing to the thermal mass compared to how much heat is going to be reflected by a bare metal surface, then it's going to heat the thermal mass up faster given the same heat flux.

If, on the other hand, it is

absorbing less heat than what the thermal mass of the plastic is contributing, then -- I'm sorry, somebody is -- can you give me just -- I'm sorry, can we take a very quick break?

Q. Sure. Let's go off the record.

THE VIDEOGRAPHER: The time is 10:47 a.m., and we're going off the record.

(An off-the-record discussion was held at this time.)

THE VIDEOGRAPHER: The time is 10:50 a.m., and we're back on the record.

Q. So just going back to the -- the -- what we were talking about at your days of Eveready/Energizer testing 18650 cells to provoke them into thermal runaway.

As you sit here today, do you ever recall a specific test that you did of a battery pack using radiant heat trying to -- to provoke thermal runaway in at least one of the cells in that battery pack?

A. Are you referring specifically to Energizer, my time at --

Q. Yeah. I want to start there, and then I'm going to take you through the rest of your career.

A. Sure. Yes -- yes. I do specifically recall us doing -- I don't remember if it was radiant or -- or if it was convective. I believe it was radiant, you know, it's -- you're -- you're stretching my memory back to, you know, to a very --

Q. Okay. Do the best you can.

A. -- to some very specific testing. I believe that we were doing some radiant heat tests, because we were looking at packs for a potential customer that was for outdoor applications, and -- where there would be a fair amount of solar heating on -- on the pack, and so there was concern as far as, you know, how, you know, how hot could the -- could the cells get within a pack due to radiant heat from -- from -- from a -- from solar source, from the sun, right?

Being left on the blacktop or something like that in -- in -- in sun, but

that was -- that was a long time ago, sir.

Q. Okay. And did you do any testing of battery packs actually in devices that were then applied -- or where radiant heat was applied?

A. I -- boy, that -- doing device-level testing in Gainesville. I believe there was -- there was some device-level testing in Gainesville, thermal testing on full-scale devices, but -- and I was part of that team, but I was more focused on the cells and the packs than -- than the device at the -- at the time.

Q. Would you agree that -- that when you take a battery pack, that the cells are wrapped -- shrinkwrapped, and then they're in their own casing and then they're put into a device that would provide another barrier to the radiation, that that would also be a factor in how quickly the radiant heat would heat the cells?

A. I'm going to go back to my previous testimony to answer that question, and -- and say that whether or not it -- it is -- will be the same, or slower, or faster

is a function of how much the packaging around the cells absorbs the heat, the radiant heat, combined with the -- the -- the thermal mass of the packaging.

So if it's absorbing the radiant heat faster than what a raw cell would absorb the radiant heat and the thermal mass of the packaging is relatively small compared to the cells, which is normally the case, because generally, the mass of a battery pack is dominated by the mass of the cells and the plastic around it, the housing is -- is generally a very minor, you know, contributor to that.

So you know, if the -- if the plastic is absorbing the heat from the radiant source better than what the battery cells would absorb the radiant heat -- from the radiant heat source, then it would actually heat the batteries faster.

The batteries themselves may not be being, you know, heated in that particular case, you've got radiant heat heating the exterior plastic, which then heats the cells through -- generally through

conduction or convection depending on the design of the battery pack.

One could imagine a situation where it might be similar, you know, the same or even, you know, heated slower depending on if there were insulation materials that were being employed and, things like that, but again, it depends on the design of the pack, and I agree that it can be different.

Q. And -- and my question really was not as much theoretical as do you have any -- any experience in actually measuring the difference in radiant heat absorption of a battery pack in a device versus cells that are exposed directly to radiant heat.

Have you had any experience directly measuring the difference in the heat absorption by the cell in those two different scenarios, and if so, I wanted to know what data you had going from that?

MS. WANEMAKER: I'm just going to make an objection to the form. Are you limiting this to his time at Eveready or --

MR. SCHWARZ: Yeah. We're going to go -- yeah. At Eveready for now. Thank you, Jackie.

MS. WANEMAKER: Uh-huh.

A. I think what we saw at -- at Eveready -- and this was true not just with lithium ion, but -- but other types of -- of batteries --

Q. Well, what I want to know, like, in the lithium ion, in particular, do you have any specific information that you can tell us that you remember about the difference in absorption in those lithium ion battery cells between when they were in a pack, or in a pack in a device, or when they were the bare cells?

If you remember actually seeing data. I don't -- I know we talked about what you think theoretically could be and there are many different possibilities depending on the materials, but I'm just asking for actual physical evidence that you saw.

A. I remember being surprised with certain pack designs that the batteries

would actually heat up faster within the pack due to -- in -- in -- with -- in -- with radiant heat than they would -- the battery cells, the cells would -- could heat up faster in -- in -- in a pack with radiant heat compared to raw cells.

Compared to convective heating of the battery pack -- of a battery pack, where the cells would be essentially insulated by the -- the plastic housing of the battery and would generally heat up slower. Again, it depends on the design of the battery pack, and you can design --

Q. Yeah. I know that -- I know that there are a lot of possibilities, Dr. Horn. I'm just asking of your personal experience, because we'll be able to get through the deposition much faster if you try to specifically answer my question.

You're being helpful and I'm not criticizing that, but I'm just saying that I was asking you for specific data that you saw in the test that you were involved with, with your team whether you demonstrated -- that you're saying that you saw it both

ways.
A. Yes.
Q. Okay. That's -- that's fine. I apologize for -- I don't mean to cut you off, but I do want to try to stick to my outline and move through this as quickly as we can and -- and get you back to your -- your day.
A. In both ways when -- I just want to clarify. When we say "both ways" being -- and you got a certain heat rate with raw cells being exposed to a certain radiant heat flux, both ways being, it could be slower with a pack, in a pack, it could faster in a pack, it could be maybe very similar in a pack depending on what materials are being used and how the pack is designed.
Q. And you don't remember any specific numbers on that, you just remember there were qualitative differences between the -- the three modes, right?
A. Yes.
Q. Okay. Now, in the studies that you did at Eveready/Energizer, you said that

you tested individual cells, but you also tested cells that were -- were wired basically in the same way that a pack would be wired, correct?

A. We tested cells in prototype packs, yes.

Q. And were they typically four or six cells wired in a -- in a pack the way a laptop computer battery pack might be?

A. I don't remember the number of cells that were in a -- in the packs. I think the packs we were looking at for the applications were slightly larger than that, but generally, you know, the packs would be wired in a combination of series and parallel cells, so, you know --

Q. So --

A. Go ahead. Please go ahead.

Q. I'm sorry, go ahead. Okay. I apologize. I talked over you and I'm not supposed to do that, and I apologize to Alexis for doing that.

So in these tests then, did you typically try to raise the temperature of the battery to a certain level to see if

thermal runaway occurred, or did you heat the batteries -- the battery packs, or the battery cells to provoke thermal runaway, or did you do both?

A. So both, you know, and at the time the -- the term "testing to failure" was becoming very popular in engineering parlance, meaning that rather than test to a specific pass level, you want to -- you want to test beyond the pass to see how close you were to failure for a specific, you know, you know, pass criteria.

Let's say that pass criterion is exposure to a certain temperature for a certain amount of time, right? So yeah. I mean, we would -- we would test up to certain temperatures, and then, you know, see if it would pass, and then analyze the product to look -- see -- exposure to a certain temperature or a certain amount of time, what that would do to the product, but then we would generally try to test to failure, because management was always -- always wanted to, well, all right, it passed here, but where is -- how far -- what is the

safety marg, right?

How far above that can we go before we see a -- we see failure, right? Is it just -- just a little bit more or is it a lot more, what's the safety margin, and you don't know the safety margin until you test to failure, and --

Q. So the answer to the question would be, yes, you tested both?

A. Yes.

Q. Okay. And with regard to monitoring the actual temperature of the cell, how did you do that?

A. Generally, at the time, it was thermocouples attached to the cell when I was at Energizer. I believe we had one infrared camera at the time, but it's -- was not nearly as fancy and sophisticated as infrared cameras are now. It was really only a camera in that you could focus on a single point and measure a temperature.

You couldn't take, like, a picture and get, like, a, you know, a colored version of the image that represented the various different

temperatures. So --

Q. Okay. So the --

A. -- thermocouples were the primary source of temperature measurement.

Q. So when you were testing a full battery pack then, would you typically attach thermocouples to each of the cells in the battery pack somehow and then use that to evaluate the temperatures inside the cells?

A. Generally, yes. I mean, the goal was, if possible, to -- to attach thermocouples to all of the cells. I wouldn't say that was done in every single situation, but I mean, you would -- to get some kind of a thermal map of the -- of the pack during -- during the heating test. That was -- that was desirable.

Q. Okay. And again, I'm really pinpointing a very specific kind of test. So that's what I'm directing this at. I know you did a lot of different kinds of tests.

So I believe you said you did tests using radiant heat in a battery pack

of multiple cells to provoke at least one of the cells into thermal runaway, and then decided what temperature it needed to get to in order for that to happen, right?

A. We -- that was a test that was conducted, yes.

Q. And you were actually physically present for those tests?

A. In some situations, I was physically present. In other situations, the testing was done offsite, and I may -- and I may or may -- I went to Gainesville, I think, three times for -- for auditing and -- and testing.

So in some cases, I reviewed data that was conducted at Gainesville. I was -- I was at the -- on the center in West Lake, Ohio. Manufacturing was in Gainesville, Florida. So although there was, you know, we -- there was a team of people, I wasn't present for, you know, physically present for -- for every test, but I reviewed -- I was part of the team that reviewed all of the -- the testing data.

Q. And what were the -- what were the cell temperatures that were required to -- to raise the cells to those temperatures to provoke a thermal runaway reaction?

A. I -- I -- I -- I don't remember specifically, you know, the -- it hasn't -- I can't give you specific numbers. I can -- I can give you generic temperature ranges.

Q. Okay.

A. So generally, you know --

Q. I'm talking about from your test, right? Not -- because we'll talk about what you've learned since then, but I'm just saying, do -- do you recall what the range was from the test or you're saying that you can apply what you know now to what you think it must have been?

A. The -- the latter of -- of -- of what you -- what you just said.

Q. Okay. So we -- we can move on then. We can talk about research that you've looked at.

Do you -- did you have any experience -- again, back in the -- in the time with Eveready/Energizer, with having

one cell be provoked into thermal runaway and then the heat from that thermal runaway reaction by convection or -- or other contact, I guess -- I guess, that's -- what was the one for that direct contact, was convention?

A. Conduction.

Q. Conduction. I'm sorry, conduction. By conduction, provoking other cells into thermal runaway, is that -- is that a type of reaction that you witnessed?

A. That wasn't something that I recall from our lithium ion testing. That was something that we were doing with lithium primary testing at the time, but that wasn't something that I -- I don't recall us being very focused on that with lithium ion testing.

Q. Okay.

A. When I was at Energizer.

Q. I've been using the word "thermal runaway reaction," and that -- that is a specific description, I guess, of a reaction that, once it gets a certain temperature, because of a breakdown within

the -- the battery chemistry itself and the battery cell, has -- is a cell sustaining, and then increasing temperature reaction, right?

Is that how you describe it or probably much more artfully than I just did?

A. In general -- generally, that's -- that's pretty much it. I think that where -- again, there's -- there's a little bit of inconsistency in -- in -- unfortunately, in -- within the industry and within academic parlance and what exactly does thermal runaway mean.

So there -- there -- there are -- there are a couple different key -- key points as you begin to heat a lithium ion cell up, a fully-charged lithium ion cell up, that are important, but thermal runaway, from a chemical engineering standpoint, if you ask just a chemical engineer what thermal runaway is, they're going to say, hey, you know, it's whenever you get a situation where the heat generated by the object causes the object to heat up, and it raises the reaction rate to generate more

heat.

So it raises the -- it increases the heat generation rate, which increases the temperature, which increases the heat generation rate, and now -- and you get a -- sustained as a thermal runaway reaction. It can be fast or it can be slow. Depends on what -- what's going on.

In lithium ion battery parlance, generally, we talk about thermal runaway as the point where you can no longer quench the reaction. So, you know, you can't throw it in water, you can't cool it down, you can't stop it through normal means. It means it's going to go to completion. That's normally what we -- when we refer to thermal runaway.

Although, some people still refer to thermal runaway of lithium ion as what most people refer to as the onset temperature, which is the temperature at which the battery will begin to self-heat. So there's -- there's a temperature where it begins to self-heat, but you can -- you can stop it by cooling it down, and there's a temperature range that that occurs, and then

there's a point where you can't stop it.
It's sort of like lighting a match, heating a match up, right? Once you actually light that match, it's into a thermal runaway chemical reaction process. You can't quench that, but up to that point, you can heat that match up pretty, pretty hot before it actually does that, and cool it back down and it will ignite.
Q. Okay. So with regard to the -- the -- the point where it's unstoppable then -- well, let me withdraw that question.
There was an article that was referenced by -- by Dr. Martin. I think the authors were -- the author was Sorensen, and did you happen to read that article?
A. Yes, I did.
Q. And in the Sorensen article, I think they talked about phases, where the first phase was sort of the normal operating temperature battery, and then the second phase was when it began to have a reaction that was generating heat, but that reaction could -- could be stopped if -- if the heat were dissipated from the cell, and then a

point where the -- the cell got into Phase 3, which was where it was, what you would describe as thermal runaway, and couldn't be stopped.

Is that -- is that parlance that you're familiar with, generally?

A. Yes. So Stage 1 is temperatures below what we would refer to as the onset temperature. Stage 2 is temperature between the onset and the thermal runaway temperature, and above the thermal runaway temperature, that's when things kind of get kick off -- kicked off and you can't stop it.

Q. And in your experience, do you -- do you have numbers or number ranges for each of those transitions that you -- that you believe are -- are fairly consistent throughout the lithium ion battery community?

A. I -- I -- I do. I -- I do.

Q. Can you tell us what they are?

A. Well, we need to specify the chemistry. So let's specify the chemistry first. When I say "the chemistry," we're

talking about lithium ion, but you are aware that lithium ion -- the term "lithium ion," really covers a wide range of -- of chemistries.

Q. Okay. So --

A. So -- I -- just -- let me just go ahead and finish with this, because I'm going to try to make your life simpler here. So --

Q. I'm always happy for that.

A. With respect to what we're talking about here, we're talking about -- in this instance, we are talking about a lithium ion cell designed in, you know, manufactured in, you know sometime between 2010 and 2020, probably sometime around 2015, forward to the electronics industry.

It is going to have a graphite negative electrode, it's going to have a lithium cobalt oxide positive electrode. That's important, because those two materials will control the temperature for onset and for -- and for thermal runaway.

The negative electrode material and the type of -- and the type and -- as

well as the surface area of that, will control your onset temperature, and then the positive is what controls your -- the temperature for thermal runaway. So given that chemistry --

Q. That chemistry.

A. That chemistry, and assuming that we're fully charged, right?

Q. Right.

A. Assuming we're fully charged, because if we're half charged, it changes.

Q. Oh, fully charged.

A. Fully charged.

Q. That chemistry.

A. Then what you're typically talking about is full onset. The lowest I've ever -- I believe we've ever measured for onset is around 70 degrees Celsius. Typically, you're in the 85 to 95 degrees Celsius range.

Q. Okay --

A. That -- that's where the -- that's where the majority is going to be. In some special cases, we may be a little bit below that. In some special cases, a

little bit above it. Eighty-five to 95 is pretty much where you detect onset, and -- and that detection is using the accelerating rate calorimetry.

That's pretty much the industry standard for -- for detecting that. It's very -- it's difficult to do, and -- and a lot of times, it's easy to overshoot and get artificially high measurements. So pretty much, the industry relies on accelerating rate calorimetry or arc for that onset temperature.

Q. Okay. So that --

A. And --

Q. And using -- using Sorensen's terminology then, that would be the point where it goes from the normal operating range Phase 1, into the beginning of thermal runaway generation of heat Phase 2?

A. That's -- yes. That is where you can start to detect and measure the cell beginning to generate heat. It's really small, really small. Typically, you're looking at .05 to .1 degrees per minute temperaturized [sic]. So very, very

temperature --

Q. Okay.

A. -- increases, but it's detectable. So that's -- that's -- and normally, when you specify an onset temperature, you have to specify your detection limits for that, but that's -- that's -- that's consistent with Sorensen transition from Stage 1 to Stage 2.

Q. Okay. And then the next transition point, from Stage 2 to Stage 3, is the point of no return, basically, when the cell goes into a thermal runaway reaction that can't be quenched even if you take heat away?

A. Correct.

Q. And what is the temperature range for that transition that you've experienced from stage -- in -- in the type of lithium ion battery we're talking about, manufactured in the year that we're talking about, what would the temperature range be for that transition from Stage 2 where if the -- the -- the reaction can be reversed or stopped, to Stage 3, where it can't?

A. Generally, between 180 and 195 degrees Celsius, and if we're talking a brand new battery, fully charged, graphite, lithium cobalt oxide, polyethylene, polypropylene, you know, bilayer, trilayer, separator, convention, you know, runt of the mill, meat and potatoes, lithium ion cell for consumer electronic applications, 180 to 195.

Q. Thank you. Now, once the -- the lithium ion battery cell of this type gets to that 180 to 195 range and gets into that secondary phase, there's usually some outward appearance of change in the battery cell itself, correct?

In other words, at some point, as the temperature continues to rise, different things are going to happen and they're not good things?

MS. WANEMAKER: Objection to the form.

You can answer if you can.

A. Well, before that, things can happen that will be visible that are not good things. So --

Q. Okay. So where does the venting usually take -- start to take place, at what temperature?

A. So generally, in this type of cell, the -- the first thing that we'll see happen is the polyethylene component of the separated mouths and the voltage will drop. That typically happens around 125 to 230 degrees Celsius.

Q. And can you see that from the outside of the cell or is that something that you know from the inside -- from examining after the fact?

A. You see that from measuring -- the continuous management of the voltage during the testing.

Q. Okay.

A. That's normally something that's done, is a -- is a voltage management. Venting of the cell is going to typically occur -- it's a little bit larger range, but -- because it depends a little bit on the head space and how much excess electrolyte is in the cell, but basically, venting is occurring because of -- of the partial

pressure of electrolyte building up within the cell, and that's generally 145 to 155 degrees C.

Again, I don't want to make -- want to make sure I'm not putting hard numbers on this. I don't want somebody to -- to come up and say, hey, this vented at 143, that's outside your range. I mean, I'm just saying, like, generally, that's a -- that's a good rule of thumb, 145 to 155 C, is where the cell will vent, and -- and in an 18650 cell, that we're talking about, two things happen when the cell vents, because it's not just the -- it's not just the vent.

The vent is part of what's called the current interrupt device component, and that will break -- that breaks the circuit of the cell. So when the cell vents, two things happen. It relieves the internal pressure, and then also, it will open the circuit to prevent any additional charging or discharging.

So when the cell vents, you will typically see that, and if you're watching the cell, you'll see that as, you know,

maybe a spray or mist coming out of the cell. If you're doing electrical measurements on the cell, the cell will go to an extremely high resistive level, because the circuit has opened.

Q. Now --

A. -- measure voltage.

Q. Let me slip in questions every now and then, and then -- then you can answer them, okay? So when the cell vents, the gases that vent, are at times, flammable, correct?

A. Yes. The -- the electrolyte in lithium ion batteries is -- is a flammable organic solvent. So whenever -- the -- when it vents -- when a cell vents, prior to thermal runaway, most of it is going to be electrolyte aerosol, which is going to be flammable, yes.

Q. And so when a cell goes through this process of going from Stage 2 -- through Stage 2, when did you start to -- to typically see flames coming out of that -- of that cell?

A. You don't see flames coming out

of the cell during Stage 2, because although, you have -- you have a -- you have something that's flammable, you don't have an ignition source, right?

So it's like you're, you know, well, I don't use hairspray anymore, maybe you do, but you take -- you can take a hairspray can and you can spray -- you can spray your head or spray it into the air, that's flammable, but it doesn't have a flame unless you, you know, put a match in front of it and then spray it, and then you have a flame, right?

So when the cell vents during Stage 2, you're not going to see any kind of -- you're not going to see -- unless there's an ignition source, unless there's already a preexisting flame, you know, nearby that, you know, is within the fuel, oxygen mixture where that is a flammable -- that's a flammable mixture. Generally, during Stage 2, we don't see any flames.

Q. Now, the -- when the -- those gases are released, they're not flammable, they're also -- we're talking about at -- at

high temperatures, correct? We're talking about 150 degrees Celsius range that that gas would be at, right?

A. The -- yes, yes.

Q. And then as that process continues, the heat continues to rise. Then you get to Stage 3, and is that where you typically will find, at some point, an explosion?

A. I want to be cautious on the -- the use of the term "explosion." Again, it's unfortunately one of those terms that is band-aided about, even -- even amongst academics and -- and professionals to mean --

Q. Well, let's just use whatever terminology you want to use. At some point, there's -- there's a rupture of the cell and cell contents can be ejected. What do you want to call that?

A. Well, I -- if you're -- you're skipping ahead a bit, because generally, we don't get rupturing of -- of the cell can in ejection of the contents like we see in this case. The most common thing that we see is

when you hit thermal runaway, right?

So when you hit 180 to 195 degrees C, and you start to begin and you -- and you start the chemical reaction between the cathode material and the electrolyte, the cathode decomposes, produces oxygen which very quickly oxidizes and burns the electrolyte.

That's when the cell temperature really skyrockets, and, you know, increases by hundreds of degrees Celsius per second. It gets well-above -- it can get well-above -- for a fully-charged cell, the melting point of aluminum. It can eject materials that are red hot. While it's ejecting those materials, it can be ejecting gases -- the gas mixture, which it can be flammable with the right amount of oxygen from air, and it's those particulates that are coming out with that gas mixture that can ignite that.

Think of it -- think of it like a propane torch that you might have in your garage or your basement for doing whatever maintenance and stuff that you use a propane torch for, right? You can turn the propane

on the torch, and there's a flammable gas coming out of that and it's not igniting, but you have a striker that you put in front of that, and then you strike an arc or a spark, and it ignites that -- that -- that probate.

Basically, what's happening for a very short period of time coming out of the 18650 cell is a flammable gas, that when mixed with oxygen from air and a spark that can be emitted from the cell itself, can emit a -- a -- a -- can ignite that -- that gas mixture.

Q. Okay. And you said then that the -- the -- once it gets to a certain point above the 180 to 195 range, the internal components of the cell can heat up to such an extent that they can -- you said, melt aluminum?

A. Generally, a fully-charged 18650 cell that gets to that thermal runaway condition, will get above the melting point of aluminum. So --

Q. And what would that be just to -- to give us a ballpark of what the Celsius

temperature would be?

A. Are you going to quote me? You're going to test my -- my memory on the melting point of aluminum. I'm going to say 660 degrees C.

Q. Okay. So that would be --

A. So you can check that on -- you can Google that and you can give me a hard time if I'm not close, but I'm thinking --

Q. No, that's okay.

A. I'm thinking it's 660 degrees C.

Q. And is that something that also you measured in these imperial tests that -- that you did when you were working for Eveready/Energizer?

A. Well, the nice thing about the melting point of aluminum is the current collector in -- on the positive electrode for a lithium ion cell is aluminum. So if you examine the cell after thermal runaway and you have a melted aluminum current collector, you know it got above the melting point.

It's very difficult to measure the internal temperature of a cell while it

is going into thermal runaway. So what we have to do as scientists and engineers that are studying these things, is we look at the -- we can sort of bracket the different materials.

So you have an aluminum current collector that melts at around 660 degrees C, as I recall. You have a copper current collector that melts at around 1,070 degrees C, I think. Don't hold me to that, though. If I have a break, I'm definitely going to Google that, but around 1,070 degrees C, I think, and aluminum melts, copper doesn't in -- in that -- in that thermal event.

So the temperature -- and this is very similar to a house fire or a building fire, where aluminum components in the fire will melt, but copper wiring won't unless there is an article -- electrical energy, you know, pass through.

So in the absence of an arc, aluminum -- or copper won't melt, but aluminum will in a typical building fire. So we know that we're in that temperature range, somewhere between the melting point

of aluminum and the melting point of copper inside -- inside the cell.

Q. And then the contents of the cell, if they were ejected, they would be ejected at about that temperature, somewhere between aluminum melting and copper melting, between 600 and over 1,000 degrees Celsius?

A. In an -- in an -- in the situation where the cell vents the way it's designed to, then in the ejecta, we call it the ejecta, that come out the vent of the cell, then yes. They will be the ejecta, which is the part -- that are coming out of the cell, as well as the gas, will be ejected from the cell within that temperature range.

Q. And sometimes the -- the cell itself ruptures or the -- the cap is blown off and the actual copper internal components of the cell are also ejected, correct, which is what happened in this case?

A. In four cells in this case, the -- the can -- so we have two cells that exhibited what we would typically call a

crimp release, and two cells that we would typically refer to as a can rupture, yes. That -- and that -- that occurs, you know, almost always exclusively due to -- to external heating of the cell, as we've been discussing.

We've only been discussing extra, you know, failure of the cell due to external heat imposed onto the cell to this point. We haven't talked about internal cell faults and other things. So we've been talking all about external heat. So --

Q. So you're saying -- let me just stop you there for a minute.

So you're saying that thermal runaway reactions that are caused by internal events in the cell overcharge, overvoltage, over-temperature, those -- those types of thermal runaway reactions never result in either a -- a crimp release of the -- of the contents of a rupture of the cell?

That -- that -- basically, if you have a -- that kind of -- of -- of fault that causes thermal runaway, you'd never see

any ejection of the internal components. Is that what your testimony is?

MS. WANEMAKER: Object to the form.

You can answer.

A. That was a very long question, sorry.

Q. Let me -- let me rephrase --

A. Counselor, can you -- can you -- can you maybe --

Q. Sure, I'll rephrase it.

So there are -- there's -- there's two different ways that you can -- you can have the internal cell temperature reach the point of thermal runaway, where these reactions take place.

You can have the external heat source or you can have a fault within the -- the system or -- or too much charge, too high of voltage. So there's two different ways, right? With me so far?

A. Sure. I'll -- I'll -- I'll --

Q. I mean, I just --

A. I'll -- I'll take those two buckets, okay.

Q. Okay. Now, in the bucket of the internal, there's a number of different ways that internal temperature can get to that point. I'm -- I'm with you on that, but I'm just talking about internal heating versus external heating.

We okay with that?

A. Yes.

Q. Okay. So I think you said for external heating, you see this reaction where -- in at least certain circumstances, the -- the copper windings of the -- the inside of the battery cell can be ejected out of the battery cell?

A. From external heating, yes.

Q. Yes. Are you saying that that never happens for internal heating?

A. For the -- the -- for the vast majority -- I may be able to come up with -- I may be able to, after over 25 years of experience, come up with a way to do it, but the vast, vast majority of the internal defects that result in a -- in a -- in a thermal runaway instant in an 18650 cell, do not result in the ejection of -- of -- of --

of contents, either through a crimp release or a can rupture.

The -- and the reason for that is the -- the venting mechanism is highly effective and specifically designed to release the gases at the rates that they're being generated at when a cell has an internal defect, as opposed to through an external heat situation, where you're pumping energy into the cell and when the cell finally fails, it's got all of its stored energy from being fully charged, as well as all the thermal energy you pumped into it.

You get much more rapid generation of gases that can overwhelm the vent and cause failure of the steel can. So that's one of the things -- and that's something that I've published on, certainly, and many people have published on, is --

Q. Which -- which -- which articles did you publish that in?

A. It's my -- it's all in my CV.

Q. No. But I mean, can you give me a specific article that you -- in the period

you -- literature that you published that makes the point that -- that ejection of the internal contents of the cell, rarely, if ever happens, from internal faults in the cell?

A. I -- I would -- I would say the great place to start is my book chapter in the Handbook of Batteries on methodologies for failure analysis of -- of batteries. So --

Q. So the good news is, I guess, it becomes pretty easy for you, that any time there's ejection of contents, it has to be from external heating?

A. Or relatively small battery packs, that -- that -- that's certainly something that we are -- we are -- we are very much looking at, and it's not just myself. I mean, there are many other people that have published on it.

Q. I didn't ask if you were looking at it. I'm just saying that based upon your understanding of the science, any time you see ejection of internal contents, it virtually has to be external heat, it can't

be any fault within the battery that caused that.

Is -- is that your conclusion that you reached just by knowing that?

MS. WANEMAKER: Object to the form.

You can answer.

A. No, sir. You've got to look at the design of the pack, and how many cells, and how thermal the thermal propagation could -- could -- could, you know, you know, how it could progress through the battery pack, you know, and -- and -- and other evidence.

So you got -- you can't just take one thing and look at it, but in general, cells don't expel their contents due to an internal cell fault. 18650 cells, designed for consumer electronics, which are different than 18650 cells designed for power electronic applications, but 18650 cells designed for consumer electronics, high-energy cells, don't expel their contents due to an -- due to internal cell faults, and the reason for that --

Q. That's sort of an axiom in the industry. That -- that's something that -- that is basically published and everybody knows that, that if you have ejection of the internal components, it must be from some external heating source?

A. Well, it's certainly published from -- by myself and -- and others, so yes. Yes, there are --

Q. Okay.

A. -- publications on that, yep.

Q. And you've never seen anybody disagree with that, like, anybody in the published literature, could be somebody like me disagree with it, but I'm saying, in the -- in the period you published literature, that's pretty much the universal belief, that any time there's ejection of the cell contents, it also has to be from an external heating source, except in exceptional circumstances you can't even think of?

A. Oh. I can think of exceptional circumstances, yes. I mean, you could -- you could charge -- you can charge -- you can bypass the -- the CID and change the

cells in an extremely high rate beyond what they're capable of taking and possibly get ejection of the contents. There may be -- you can -- you can plug the vents.

We get -- we -- we -- we do this by design. We, you know, in order to understand what the pressures, internal pressures, need to be to cause can failure, we -- we will design experiments to plug vents and to -- so we can measure what those pressures are for the can to fail and things like that.

So I mean, you can -- you can do that, and there may be applications out there, where vents are plugged. I mean, there -- there are many different uses of 18650 cells, where vents could be plugged due to -- from debris, from, you know, from -- from contamination of intrusion of moisture or other things can affect how, you know, how the vents -- or the design of the cell -- the design of the pack.

One could potentially, you know, plug the vent just based on how you -- you attach -- you attach your -- your leads to

the -- to the cell or if you pack in some -- in some cases, some people feel that packing in insulation material around the cells is a good thing or incapsulating the cells in epoxy is a good thing. Those types of things can reduce the rate at which the gases can come out, right?

So in no way, shape, of form am I saying, I can look at a pack at post-fire, see its expelled contents and say, (untranscribable noise), that was external heating. What I am saying is, in the absence of things, you know, could potentially block, you know, crazy different scenarios, and I can come up with many of them, what we see -- and this is based on 25 years of experience in the industry, doing almost exclusively battery failure analysis is, you don't get expulsion of contents from 18650 cells due to internal cell faults.

Expulsion of contents is almost always a very strong indicator that you had external heat attack. Especially in situations where you have multiple cells or

most of your cells from a pack have expelled their contents. That is very, very compelling strong evidence that you have external heat attack.

Q. Okay. Thank you for that answer. You have a list of litigation cases that you've worked on the last four years that have been provided, and I don't want to go through each one of them, but I wanted to ask you: Did -- which of these, if any of them, involved 18650 batteries that went into thermal runaway?

A. Okay. So this is Appendix C. Sorry -- sorry for turning my head over here, I got this -- I got my folder off to the side. So this is Appendix C, correct?

Q. Right.

A. Okay. So let me -- okay. So one page, 1 through 8. So let me just go through these very quickly. Number one --

Q. You don't have to tell me about each one of them, just tell me which ones involve thermal runaway.

A. I'm going to -- I'm just going to go through it really quick, say "yes" or

"no."

Q. Okay. Thank you.

A. Yep. "Yes" means, yes, it's thermal runaway and applies to 18650s. "No" means it does not.

Q. Thank you.

A. Number one, no. Number two, no. Number three, yes. Number four, no. Number five, no. Number six, no. Number seven, yes. Number eight, no.

Q. Okay. So the two "yeses" were cases where you worked for Hewlett-Packard, correct?

A. Correct.

Q. And were they -- they were both 18650, you said?

A. Correct.

Q. And were they fire or explosion events?

A. They -- they -- they were events where there was a fire, and the batteries in a notebook computer were alleged the source of the fire.

Q. Okay. And there's another expert for HP that has testified in this

case being Mr. Galler, do you know him?
A. I do know Don Galler, yes.
Q. Was he involved in any -- either of those two cases; do you recall?
A. I -- I don't recall. Let me -- let me -- just looking at the years, no. I -- I know that in -- well, so the two cases -- so three and seven are basically the same case, right?
So -- so that's, you know, the three is the trial and seven is the deposition. Yeah. So -- so -- and I -- and I do remember the trial, specifically. I was the only expert that -- for HP that testified at that trial. I don't know -- so I don't recall if Don Galler was involved with that case or not.
Q. Did -- did those HP laptop fire cases involve unauthorized battery packs for that case -- I guess just one case?
A. It did not.
Q. Did not, okay. And I assume, in -- in those cases, you determined that whatever happened -- where the fire had nothing to do with the HP battery pack,

correct?

A. Correct. That -- that damage to the pack, and it was -- was a result of external heat on -- on the battery pack, yes.

Q. Now, have you -- this only covers your last four years. Have you been involved in any HP cases -- Mr. Galler testified that in most of the fire cases he's looked at for HP, there was an unauthorized battery pack that was involved with the fire and explosion from the -- from the HP laptop.

Has that been your experience as well?

A. I can only think of one other case that I've been involved with HP that involved an unauthorized battery pack.

Q. And when was that?

A. I -- I -- I don't -- I don't have an -- I -- I -- that -- that was an international case, and I was not deposed and -- and did not testify. So it wouldn't -- it wouldn't be in my testimony list anyway even if we went back.

I want to say that that was probably seven years ago, maybe eight -- six years ago -- five to six -- I'm -- I'm guessing.

It was -- it was a minor case that was -- an international case that I -- I was -- I was involved at the periphery, but I haven't testified on -- on any other cases or written any reports on any other cases involving HPs that were using non-authorized batteries; to my recollection.

Q. Have you ever studied unauthorized battery packs looking for whether safety features were incorporated into those for HP?

A. For HP?

Q. In other words, have you ever worked for HP to do that type of investigation? That was a poorly-worded question.

A. I think only on that -- that international case that -- that I mentioned.

Q. Okay. If you turn to Appendix A of your report, and that's entitled

"Material Reviewed."
A. Yes.
Q. And are these the materials that you looked at in preparation for your report prior to the -- the completion of your report?
A. Yes. Yes, they -- they would be, yes.
Q. Okay. So among them, were the reports of the plaintiff's experts, the first three, correct?
A. That's correct, yes.
Q. And you looked at the Allegany Fire Investigation Report and all the photographs that came with that?
A. Correct.
Q. And then you looked at the deposition testimony of Carol Marcellin, who is in the house, and Lee Atkinson, who's the expert in -- that works for HP?
A. Yes. I'm not sure that it was done in -- in that specific order, but yes.
Q. Okay. Well, that's the order they're listed in. I didn't mean -- I read them in that order.

A. Yep.

Q. And Mr. Atkinson also testified in his deposition that you were at, about his investigation of fires that resulted from unauthorized battery packs; do you recall that?

A. I -- I do.

Q. And --

A. I mean, I recall -- I recall reading it. I don't recall the specifics.

Q. Okay.

A. So if you're going to ask me questions about his deposition, I -- I would say that you may have to point me to specific --

Q. Sure. But do you recall him saying that -- that he became aware during investigations of fire cases that there were unauthorized battery packs that lack safety devices that were required by HP?

A. I -- I recall that -- I seem to recall -- again, I recall him saying something to that effect, that -- that HP started to see instances around maybe 2018, 2000 -- and they implemented some systems in

2019.

Q. Okay.

A. Something to that effect, but I -- I could have my dates wrong. I recall -- I remember -- I recall him saying something to the effect of -- and it was either -- I think it was Lee Atkinson.

I recall seeing something in -- either in the -- it was Atkinson's deposition or it was in Interrogatories, I -- I don't recall which.

Q. Okay.

A. But it was said that -- that, you know, there was a period of time where HP -- that HP really wasn't concerned about it, because they weren't seeing, you know, any significant prevalence of -- of -- of issues, and then at some point, they started seeing -- they started seeing it, and so they implemented some fixes.

Q. Okay. Did you review the testimony of the other HP witness that was deposed in this case, Mr. Pipho, P-I-P-H-O? It's not listed here, but I just was wondering.

A. I don't recall -- I don't -- when -- at the point -- I don't think that I did review that. I -- I may have seen some snippets from it, maybe in Dr. Sala's report, but I -- I don't think that I actually read -- read that deposition.

Q. Okay. And then number seven on your list is the scene inspection notes and photographs of Greg Gorbett, and those were items that you looked at in order to prepare your report, correct?

A. Correct. And in fact, I believe I include some of Mr. Gorbett's photos in -- in -- in my report.

Q. But you recall specifically reviewing the scene inspection notes and photographs of Mr. Gorbett, correct?

A. Yes. I -- I believe I received a folder with -- a PDF folder with -- with photos and -- and photos of some notes that he took during the inspection.

Q. Okay. And Mr. Gorbett was the -- the fire investigator expert that was sent by HP to go to the investigation of the scene of the fire in February of 2020,

correct?

A. That was before I was involved with the case, but -- but that's my understanding.

Q. And when did you get involved in the case?

A. That's a good question. Hold on, let me see if I got the -- the project number.

So the project number on my report starts with 21. 2110, so that would be late 2021 would have been when I was retained, because that was when the project was authorized. So late 2021. I can -- I know it's late 2021, because the project number is 10,054, and we typically have around 11 to 12,00 projects a year in Exponent, so --

Q. So with regard to Exponent then, there's another Exponent expert that has testified and that's Dr. Myer [sic]. Do you know Dr. Myers?

A. I -- I -- I do know Dr. Myers.

Q. And would the project number for you be different than the project number for

Dr. Myers?

A. Yes. I believe in this particular case, it would be, because we were retained -- yeah. It would be different. I would -- I would think it would be different -- normally -- normally, the project number goes with the expert.

Whether or not the -- as opposed to the -- the -- the matter. So if there are multiple, you know, Exponent experts on a particular project, then there would typically be different project numbers.

Q. So then you -- you list the lab inspection notes and photographs of Don Galler, correct?

A. That is Item 8, yes.

Q. And Don Galler was the HP expert that went to the laboratory where they took the materials that Mr. Gorbett and others chose to be analyzed in a laboratory.

Mr. Galler was there to -- to witness that laboratory inspection?

MS. WANEMAKER: Object to the form.

You can answer.

A. My understanding is that -- that Galler was present at at least one inspection of the -- of the evidence at a laboratory, yes.

Q. Right. So in other words, Mr. Galler didn't go to the scene. Mr. Gorbett went to the scene with others and you list those others, we're going to get to that, in your report, and then they chose certain items to bring to a laboratory, and Mr. Galler went when they did that examination in the laboratory of the items removed from the scene?

A. That was a very long question that had many questions folded into it. So I don't think I can say a "yes" or a "no." If you could divide that up for me, that would be fantastic.

Q. Well, what -- what was it that Mr. Galler -- what -- what items were looked at that when they went to the scene -- I'm sorry, withdraw that question.

Mr. Galler went to the laboratory and it was the fire research technology laboratory in Sodus, New York,

where certain items were evaluated in October of 2020 or, you know, later in the year that the fire occurred, correct?

A. That's my -- yes, that's my understanding.

Q. And what was your understanding of -- of where the items came from that were evaluated during that examination?

A. I -- I -- I would point you to Figure 10 of -- of my report, which has a -- a listing of the -- of the items.

Q. Right. But I was asking if -- if -- where those items that are listed there came from.

A. I -- I -- I guess I don't -- I -- I would -- I don't --

Q. What did --

A. I don't --

Q. Did they come from -- did they come from the scene of the fire?

A. That's my understanding.

Q. Okay. That's what I wanted to know. That was part of my long question.

I said that a selection was made in February by the investigators of things

to take to a laboratory, they were taken to a laboratory, looked at in October, and Mr. Galler was there when they were looked at?

A. Again -- again, you got to divide that up. I have no idea when the selection was made, whether it was February, what year it was. Certainly before 2020, I -- I don't know. All I can say is, that's what I understand -- Figure 10 in my report is what Galler looked at, so --

Q. And -- and just so I -- do you know when the fire was?

A. Make sure I get you an accurate date. January 24, 2020.

Q. So the items that were taken, were taken at least after January of 2020, correct?

A. That would be my understanding, yes.

Q. Okay. Then your list of items -- turn back to it, I apologize.

A. You're -- you're referring to Appendix A, list of --

Q. Appendix A, yes. You -- you

list an article by somebody named -- is it Bankole or Bankole?

A. Which number? Yeah.

Q. Twelve?

A. Yeah, Bankole.

Q. And then you list an article written by the lead author, Yuan?

A. Yes.

Q. And then 14, you list the National Fire Protection Association Guide for Fire and Explosion Investigations from 2017?

A. Yes.

Q. Now, is that -- is that what's also called 921?

A. Yes, it is. Yes, it is.

Q. And so you looked at the 2017 version, not the 2024 version?

A. I've looked at the 2017 version, yes.

Q. Okay. You understand there has been an update since then?

A. I do, yes.

Q. Okay. And then you list an appendix by somebody named Reddy?

A. Correct. That's the -- Reddy is the editor of the Handbook of Batteries, yes.
Q. Okay. And what is that particular -- that's the appendix that relates to battery failure analysis?
A. Yes. As -- as -- as it states in the document there. Appendix H, Methodologies For Battery Failure Analysis, yes.
Q. And then you list two United Laboratories specifications?
A. Correct.
Q. And then what's the last one, 18?
A. In an -- it's an international standard testing of -- of lithium ion batteries.
Q. And is that the sum total of everything that you reviewed to prepare for your report?
A. I think it's the sum total of things that I went back to specifically review. Obviously, you know, you know, I -- I know a lot from, you know, 25 years of

doing battery failure analysis. So there's -- there's a lot of, you know, just inherent knowledge that I rely upon, but -- but yes. Those -- that's the material that I reviewed for this specific case, yes.

Q. Since you've -- you've produced your report, have you looked at other materials about this case prior to today?

A. Certainly I have, yes.

Q. And would that include the -- the reports -- the rebuttal report of Dr. Martin and the rebuttal report of Mr. Karasinski?

A. It would, yes.

Q. And what else would it include?

A. It would include the rebuttal report of -- oh, I can never think -- remember his name. It starts with an L. He's another fire investigator.

Q. He didn't do a rebuttal report. So that would be his --

A. Oh -- I guess I reviewed the primary report after -- after I submitted my report. So I have reviewed that. I've reviewed the -- sorry, I don't have a list.

I've reviewed the -- as I've said, the rebuttal report of Martin, as well as -- there -- there were some new references and citations in Martin's rebuttal report that were not in his opening report that -- that I've reviewed. I've reviewed Martin's deposition. I've reviewed -- is there anything else --

Q. Did you review Mr. Galler's deposition?

A. No, I didn't review Mr. Galler's deposition. I did review Dr. Myers' report and Dr. Sala's report. As -- as -- as -- there might be some other documents, but that's what I recall at this point.

Q. No, that's great. So let's move on then to -- and I know it's getting close to noon --

MS. WANEMAKER: Yeah.

MR. SCHWARZ: But -- why don't we go off the record.

MS. WANEMAKER: Yeah, good idea. Thank you. I was just --

THE VIDEOGRAPHER: It's 11:55, we're going off the record.

(An off-the-record discussion was held at this time.)

THE VIDEOGRAPHER: The time is 12:10 p.m., and we're back on the record.

Q. So I think in your -- in this morning's testimony, you provided -- your general opinion, you said, is pretty universally held, that catastrophic failures of lithium ion battery cells form thermal runaway are almost exclusively caused by external heat sources; do you recall that testimony?

A. I just want to make sure -- when you say catastrophic failure, what you're referring to, I believe, correct me if I'm wrong, is failure of the -- and we're talking specifically cylindrical 18650 cells and we are talking about the failure of the can, two types of failure, we see both in this particular instance.

What we would generally call a crimp release and a can rupture. Those are generally a result of external heat attack, yes. As opposed to an internal cell fault

mechanism.
Q. And I think you -- you said, not only generally, but the majority, but 99.9 percent, right?
A. I --
MS. WANEMAKER: Objection to form.
You can answer.
A. I didn't put a number on it, but the vast majority, yes.
Q. Okay. And the 18650 are the most common cells used in consumer products, correct?
A. Not -- not currently, no. That -- that would be incorrect. For consumer product laptops, phones, tablets, generally nowadays, it's either prismatic or -- or pouch cells.
Q. Okay. But at -- at -- during the period of time prior to the current time, 18650s were predominate, at least for laptops, correct?
A. I want to say in 2010 for notebook computers, I would say that -- yeah, 18650s were -- were the -- were -- I

don't recall what fraction, but I think that they were the majority. More than 50 percent would have been 18650s, yes.

Q. So in the -- if you turn to Tab 18, and I've marked as Exhibit 2, that's the Yuan article that you referenced in your report.

(Exhibit 2, Yuan Article, was received and marked for identification by the reporter.)

A. Yes, I am there.

Q. And in that report, in the introductory section, if you look at it, there's a sentence in the first column that says, the Occupational Safety and Health Administration (OSHA, 2019) reports that the U.S. Consumer Product Safety Commission identified over 25,000 overheating or fire incidents involving more than 400 types of lithium-ion powered consumer products over a five-year period.

Did I read that correctly?

A. Yes.

Q. And so the -- the overheating and fires caused by lithium ion batteries

has become a -- a major issue in the last decade; would you agree with that? 25,000 incidents.

A. I mean, I guess. I think the numbers, I guess, speak for themselves. I don't know if I want to put a, you know, gauge, if that's, you know, the severity of that, but that's -- that's -- that's what CPSC has reported, yes, according to Yuan.

Q. Right. And you -- you cited this article, so I assume you cited it, because it was a reliable source for information like this?

A. Yep, yes.

Q. Okay. So the next says, the safety issues pose a great challenge for the wider application of lithium ion batteries in large power-consuming devices, and that would include electric vehicles, correct?

A. It -- it -- it would include electric vehicles, yes.

Q. And the next sentence says, the major cause for catastrophic failure of -- for lithium batteries is thermal runaway that occurs when heat generated from

exothermic reactions inside a battery outpaces heat dissipated from the battery leading to a rapid increase in temperature and pressure that further increases the reaction rate.

Did I read that correctly?

A. Yes.

Q. And you would agree with that, correct?

A. Yes.

Q. And the next sentence says, if unmitigated, this self-accelerating process will lead to cell rupture and the venting of toxic and highly flammable gases, and the release of heat.

Do you agree with that?

A. I -- I -- I agree with it to a certain extent in -- in that -- again, unfortunately, this is a situation where the term "rupture" is not universally agreed upon, and also keeping in mind that, you know, we're talking about lithium ion cells in general.

So when we talk about rupture of a cylindrical cell, that's different than

rupture of a pouch cell or rupture from a prismatic cell. The latter two, pouch and prismatic cells, tend not to have dedicated venting mechanisms.

So generally, the casing itself, either the pouch or the prismatic can, will -- will tear, if you will, and that's generally what we refer to as -- as a rupture. I cannot think of the exact standard. It's a European standard that defines rupture as a situation where, you know, the -- the -- the cell separates until -- into two or more major components, but in general, yeah, thermal runaway will result in, you know, the -- the emission of -- of -- of chemicals and materials that are generated by the thermal runaway reaction during -- during that process.

Q. And two of the six cells that ruptured in this case, based on your definition of "rupture," correct?

A. Two of the six cells exhibited a rupture, which is the tearing of a steel can, and -- and -- and the -- two of the six cells exhibited a crimp release, which I

would -- I would denote as a special character -- a special rupture situation, where the can doesn't tear or -- or, you know, the can stays intact. It's the crimp that unfolds and contents are ejected, yes.

Q. And the next sentence says, an ignition of those flammable gases can lead to a possible explosion or fire, correct?

A. That's correct.

Q. And then in the next paragraph, it says, lithium battery thermal runaway can be caused by exposure to excessive temperatures, internal shorts due to cell defects, external shorts due to faulty wiring, a surge in the charging or discharging current, or mechanical damage to the cell that can lead to internal shorts and heat generation.

Did I read that correctly?

A. You did, yes.

Q. And do you agree with that statement?

A. I -- I agree with it in that it -- it encompasses, you know, there are -- there are other situations that can cause a

thermal runaway in a lithium ion battery, but I agree with those, yes.

Q. Okay. And those would include charging and overcharging, surging charging, or over-temperature, correct?

A. Correct, yes. I mean, to just -- to be -- to clarify, not every overcharging situation is going to cause thermal runaway. Not every surge charge current is going to cause thermal runaway, but -- but those things can depending on the severity of -- of them.

They can -- they can in certain situations result in that. Not always, but they can, yes.

Q. Now, going back to your report, which is Tab 1, Exhibit 1, and if you turn to Page 5.

A. Give me just a second. I -- I got to go to the beginning of your binder. That was at the very end. So give me just a second, get back to that. I feel like I'm going from the yellow pages to the white pages in the phonebook. I guess that maybe dates me.

Page -- page number again, I'm sorry?

Q. Page 5.

A. Okay.

Q. And you have -- in the beginning of your report, after you do your qualifications, you -- you provided your two opinions and they're going to be discussed more in the body of the report and then summarized at the end, correct?

A. Yes.

Q. But the first opinion was that the -- the battery pack of the alleged subject HP Pavilion DV6 Notebook Computer was inconsistent with the genuine original battery pack that would have been sold with this HP model.

That's your opinion, correct?

A. Yes.

Q. And then the second sentence says, as such, protections provided by the original pack may not have been present in the battery pack that was installed in the notebook at the time of the fire, which could have led to degradation of the

performance and safety characteristics of the cells.

Did I read that correct?

A. Yes.

Q. So that -- that combined, is your first opinion, those two sentences that I read?

A. Correct, yes.

Q. Okay. Now, if you could turn to Tab 15 that I marked as Exhibit 3, and this is a Texas Instruments Application Report from 2005.

(Exhibit 3, Texas Instruments Application Report, was received and marked for identification by the reporter.)

Is this a document that you reviewed in preparation for your testimony today?

A. Yes, it is.

Q. And this is a -- Texas Instruments is one of the -- the leading chipmakers that provides parts to the computer industry, correct?

A. Yes, it is.

Q. And specifically, Texas Instrument [sic] makes a microprocessor called a fuel gauge that is frequently incorporated into battery management systems?

A. Yeah. Again, I'm -- I'm not an electrical engineer, but -- so I'm going to just qualify that, but my understanding is that, yes, Texas Instrument [sic] chip sets, you know, a fuel gauge, can be incorporated in -- into -- what is generated, called a fuel gauge can be incorporated into the -- into the chip or the design of the circuit. That's my understanding.

Q. Well, you -- you have some familiarity with battery management systems, correct?

A. I have familiarity with them with respect to, you know, what is generally -- or what can generally be used in -- in a battery management system, yes.

Q. And -- and battery management systems almost universally have fuel gauges. The reason they're called fuel gauges is one of the functions of that microprocessor is

to keep track of how -- what the state of charge of the battery pack is, correct?

A. There -- my understanding of the term "fuel gauge" is that it is -- again, one of these terms of art that can mean many different things. In general, my understanding is that it provides some sort of -- at -- at a minimum, some sort of an indication of the charge of the battery.

How it does it, the level of sophistication that is involved, whether it's simply looking at the voltage of the battery, either unloaded or loaded, or if it's doing what's called coulomb counting, things of that nature, or other more-sophisticated techniques, you know, is, you know, that -- that all goes into.

Again, not my area of expertise. I've never designed a fuel gauge system, nor have I tested fuel gauge systems in -- in battery packs, but that's my general understanding, is it is an attempt for -- of the electronics to determine and report -- be able to report the -- the user of the device, you know, an -- an estimate of what

the battery -- how much longer the battery will last under a given operating load.

Q. And again, this may be beyond your expertise, but -- but the fuel gauges that were made by Texas Instruments also provided a number of the safety systems that are required for lithium ion battery protection, such as protection against overcharge, protection against overvoltage, protection against over-temperature and cell balancing.

Is that your understanding or is that beyond your expertise?

A. Again, I don't -- this is a 2005 document, so it's 25 [sic] years ago. If you're asking me what Texas Instruments was doing with their -- with their chip sets back in 2005 as far as, you know, I don't know if it's a single chip that's doing all of this or if it's a -- if it's a chip set that's doing it.

I -- I -- I, you know, but -- but my understanding is that Texas Instruments, even back in 2005, was -- was designing chip sets and chips for -- for

battery management systems.

Q. And you said that in -- in your first opinion that I read, and -- and you can look back at it if you need to, but you said that the -- the fact that this was an unauthorized battery pack may mean that it -- it lacked certain safety systems that a normal battery pack would have?

A. It --

MS. WANEMAKER: Object to form.

You can answer.

A. Let's -- let's -- let's just make sure that we go back to -- to that.

Q. Sure. On Page 5.

A. Yep.

Q. Tab 1.

A. I'm going -- I'm going to keep my finger in Tab 15, so I can get back to that one quicker. So what I -- what I said is, in -- in --in the Primary Opinion No. 1, such protections provided by the original pack may not have been present in the battery pack that was installed in the notebook at the time of the fire, which could have led to degradation of the

performance and safety characteristics of the cells.

Q. Right. So that's what I was asking you is, that what you're referring to there, are some of the safety systems that I've described, such as cell balance, overcharge, protection -- overvoltage protection, over-temperature protection, correct?

A. Those are not all necessarily safety systems, but those would be systems that may not be employed by the -- by the instant battery pack.

Q. So you don't -- which ones that I just described would you say are not protection against those -- those states, overcharge, over-temperature, overvoltage, or cell imbalance? Which of those would not be safety systems in your view?

A. So cell imbalance is not necessarily a safety issue as long as individual, you know, cells or cell blocks are -- are not overcharged. In fact, many battery packs don't employ a balancing system, because a balancing system can

actually be a negative with respect to -- to safety.

Think of it in -- in this way: If you happen to have a defective cell --

Q. Well, actually, I'll stop you. If -- if -- if -- if you're saying that cell balance is one that you would not include as a safety system, that's really the answer to the question.

A. Not -- not necessarily. Again, the devil's in the details, but that's -- that's -- that's -- that's one, and again, overcharge protection, you know, again, where's the overcharge, are we talking about overcharge, are we talking about over-current, but that -- that -- that, you know, if we're talking about over -- overcharging to too high of a voltage, that -- that -- that can certainly make a battery more susceptible to exposure to high temperatures, sure.

Q. Okay. So that's the only thing that you worry about with overcharge, not that that could, by itself, put a system into thermal runaway, overcharge

exclusively, is a danger only if there's external temperature exposure; is that your opinion?

MS. WANEMAKER: Objection to the form of the question.

You can answer.

A. It's not a blanket opinion, because we -- again, we -- we have to focus on the cells at issue in this case, which are 18650 lithium ion cells. If we are talking about pouch cells or prismatic cells, overcharging is -- is -- is really crucial on -- on the safety aspects of those cells, because they do not have current interruptive devices that are incorporated into the vent design in those form factors.

18650 cells do have current interruptive devices that are incorporated into the vent. So when you overcharge an 18650 lithium ion -- when you overcharge any lithium ion cell, you generate gas pressure, you generate gas inside the cell, and when that pressure gets to a certain level in an 18650 cell, the CID or the current interrupt device will operate, will activate.

As described in my report, there's a section of CIDs, and it -- and it does -- it does -- that section specifically states that it's a protection against overcharging. It's extremely effective, because when it activates, it's not a reversible activation. It actually activates permanently.

So it prevents the cell from being overcharged beyond the state where it will activate the vent. When I say it activates the vent, it activates the vent long before you get to the point where you even have -- you even hit the onset temperature. So it activates the vent by design in Stage 1.

So when you're talking about overcharge of a battery system that employs 18650 cells, which have inherently a current interrupt device incorporated into the vent assembly, then overcharging is -- is really not an issue with -- with those cells.

Especially when we're talking about, you know, slight repeated overcharging, like, what you might have in a

pack like this, you know, in -- in -- in the instant pack. If it's a pouch cell or if it's a prismatic cell, then overcharging is a serious issue, because you don't have the cell level protection against overcharging.

So 18650s are sort of, I guess you could say, maybe a special case or at least the, you know, a case where overcharging is not really a significant problem from a safety perspective.

Q. Okay. And that's universal, all 18650 cells, none of them have really a danger of overcharge causing a fire?

A. Not overcharging in, like, what would be capable in a battery pack in a notebook computer, correct.

Q. Okay. So -- okay. I just want to make sure I'm clear.

So in your opinion, there's not really any safety aspect of overcharging an 860 -- 18650 battery because of this inherit design within it that would prevent any -- any danger of fire from overcharge?

A. Correct, and, you know, and I base it on, you know, hundreds and hundreds

of testing -- tests that -- that -- that we've done at Exponent on overcharging 18650 cells.

It's -- unfortunately, it's -- from an experimental standpoint, it's -- it's -- it's really problematic, because you really like to get the cell to have a thermal event by overcharging for various different things that you might be trying to measure from, you know, from a thermal runaway event, but the CID activates before you get to that point.

So generally, when we're looking at studying the effects of overcharge on safety of 18650 cells, we're looking -- doing pouch cells and -- and -- and/or prismatic cells. What we --

Q. Do you have any -- any literature references that support your opinion that 18650 cells do not have any overcharge safety dangers associated with them?

A. I mean, I guess what I would do is, I -- I would initially point to you -- to the -- point to the standards, because

the standards --

Q. I mean -- I'm talking about specific statements that 18650 batteries -- battery cells are not going to go into thermal runaway from overcharge because of this system that you say is a fail-safe system that will prevent that.

Do you have a reference for that?

MS. WANEMAKER: Object to the form.

You can answer.

A. Again, you know, where -- where I would point you to -- off the top of my head, I -- I can't -- I can't come up with a specific reference for you, but I would point you to the -- the -- all the international and national standards, which all subject 18650 cells to an overcharge situation, and then require that those cells do not have any kind of a thermal -- thermal event or -- or fire or explosion.

The same is true for overdischarge, which also generates excessive gas. Again, the CID, the vent

mechanism is extremely resilient from a standpoint -- from a -- from a safety perspective. There are ways you can bypass that, but -- but generally, when we're talking about, you know, limited charge capability of the -- of the computer to, you know, charging rate and -- and things of that nature in the computer environment itself, then yeah.

It's -- overcharging and over-discharging on 18650 batteries is -- is not a -- a safety issue. It is certainly a performance issue, and it's a safety issue if you're talking about exposure to elevated temperatures, because an overcharged cell, even if the CID has activated, is going to have a lower, you know, slightly lower onset temperature and will be maybe more susceptible or more reactive when exposed so external heat.

So it is going to make the cell less resilient from a heat -- external heat exposure standpoint, but the safety mechanism is incredibly robust with respect to these -- these events causing the cell to

have a thermal event assuming that -- assuming that you're -- assuming that you're operating the cell within its designed specifications.

Q. Okay. And so for 18650 cells then, they don't view overcharge, over-temperature protections as safety features, because these cells can't go into thermal runaway for any of those conditions other than from external heat source?

A. Assuming that you're operating the cell under, you know, in -- within its nominal specifications, you know, charge, you know, charge rate specifications, its nominal temperature, you know, specifications, you're not exposing it to external heat, then that is correct.

Q. So this exhibit that we marked, which I've marked as Exhibit 3, Tab 15, the Texas Instrument, he talks about -- the first paragraph talks about multiple devices now that are powered by these -- these batteries and that this has opened a huge market for counterfeiters to supply cheap replacement batteries and peripherals, which

may not have the safety and protection circuits required by the original equipment manufacturer; do you see that?

A. This is the first paragraph on Page 1 of the Texas Instrument Application Report from 2005?

Q. Under "Abstract," yes.

A. Yes, I see.

Q. And is this -- is that something that you were aware of in 2005 then, that -- that counterfeit battery packs were being sold below the -- the -- the cost of authorized replacement battery packs and that some of the manufacturers of those counterfeit battery packs were skipping the safety devices?

MS. WANEMAKER: Object to the form.

You can answer.

A. Yeah. It -- it was not seen at the time as -- as -- as a significant issue in the industry, as -- as -- as I -- as I recall in that -- in the 2005 timeframe.

Q. Now, Texas Instruments was reporting on it, but you're saying it wasn't

a big deal?

A. Well, I mean, you're -- what -- this document is -- is a marketing report, right? Texas Instrument is trying to convince people to purchase their -- their -- their product, right? So -- but yeah.

I -- I as -- as a battery expert back in 2005, and I was definitely in the battery industry back -- back in that timeframe, and doing battery failure analysis, was not aware of counterfeit batteries in devices as being a significant issue, you know, so --

Q. So at some point after that, Mr. Atkinson testified that he became aware of it at HP, though, right?

A. I believe he -- in, you know, around -- as -- as I recall, again, I may have the year -- I may be off by a year or two, but I believe in the late 2000 teens, around maybe 2017, 2018, some -- some -- in that timeframe. Yes, it started to become more of an issue.

There -- there are industry reasons for why it wasn't a big issue back

around the 2005, early, mid, early to mid 2000, you know, 2000, 2010 timeframe, why things started to get a bit more of a concern in the late 2000 teens, but that's -- I believe that what Atkinson was saying, was that, yeah, HP began to see that as becoming an issue in the late 2000 teens.

Q. And you didn't read Mr. Pipho's deposition, you said, right?

A. I -- I don't think I did, no.

Q. Okay. So it surprises you to say that he know about it in the early 2000 teens, that would be a surprising statement to you?

A. I -- I -- I have a -- I -- I would -- questions like that, if you have something that you would like me to read from his deposition, I would be happy to do it and comment it -- comment on it, but I would want to read it in context.

Q. Sure. Well, I thought you were saying, universally, no one in the industry knew about a -- a wide-spread danger of counterfeit battery packs that lacked safety features until the late 2000 teens, and I

just was asking you if -- if Mr. Pipho had disagreed with that, would that surprise you, and you're saying you would have to read Mr. Pipho's deposition to know whether it surprised you or not?

MS. WANEMAKER: Object to the form.

You can answer.

A. Counselor, I believe you misrepresent my testimony. I did not testify that nobody in the industry was aware of anything in the early 2000 teens.

In fact, we can have the court reporter go back and -- and -- and reread my testimony on that just so that we're clear.

Q. Okay. So in 2005, some people in the industry were aware of this problem, because Texas Instrument printed it in this article, correct? Do you agree with that?

A. No, I do not. I would -- what I would agree with is that Texas Instruments decided that they had a product that they wanted to sell to the industry, and that this is a marketing report, the marketing paper that says that, hey, look, if you've

got that problem, if you see that there's a problem here, we may have a solution for this problem. Again, it's not a peer-reviewed paper, it's a marketing white paper.

Q. Okay. So in your view, was Texas Instrument inventing a problem so they could sell a device; is that what you're saying?

A. What I'm saying is that I was certainly not aware of a significant problem in the industry in the 2000, 2010 timeframe with respect to counterfeit and/or counterfeit batteries in consumer product applications.

Q. And you only learned of that later?

A. It become -- it became more of an issue in the mid to late 2000 teens, certainly.

Q. Okay. But you certainly were aware of it by 2020?

A. Yes, yes.

Q. So when Texas Instruments' paper is indicating that the counterfeit battery

packs may not include certain safety devices, are those the same types of safety devices you're referring to in your Opinion No. 1 that may be lacking in counterfeit battery packs?

A. I -- I would imagine that they would be -- that some of those would be.

Q. Okay. So if you would turn to Tab 7, which I've marked as Exhibit 4, and this is, I think, the document that was included in your list of materials that you reviewed.

(Exhibit 4, Tab 7, was received and marked for identification by the reporter.)

A. Let me go back to my list of materials, just to make sure that this is indeed the -- the same document. So bear with me.

Q. It -- it starts with HP01378, which are the documents that were produced by HP in this case, but certainly, take your time.

A. Which items specifically on the "Materials Reviewed" are you referring to?

Q. The production of HP documents, I think is what it's described as. HP production documents.

A. Okay. Okay. I mean, I -- so for -- for -- for -- for the record, I mean, that was a large number of documents, you've got a specific document here. I'm happy to, you know, just answer questions about this if you have specific questions.

I -- again, you know, it may or may not have been in that production that I looked at. Obviously, I haven't admitted the entire production to -- to -- to memory. So I -- I can't say as I sit here if this is exactly the same document.

Q. All right. Let me ask you this: In the generic sense, did you review any HP specification for the authorized battery pack for this type of laptop that was involved in this fire?

A. Yes, I -- yes, I did.

Q. Okay. And if you look at this, does this appear to be -- first of all, it's got an HP production number on the bottom, so it was produced by HP to us in this case,

involving a Pavilion laptop, and representing to us -- represented to us, that this is the specification for the six-cell battery specification for this particular laptop.

Do you have any reason to disagree with that?

A. I -- I do not, and I -- for -- for the purposes of any questions that you have for me, I will assume that I -- that this is the spec for the -- for the battery pack for the instant laptop and that I have looked at this.

Q. Okay. And would you agree with me that -- the spec for the battery pack that was authorized for the laptop would be an important piece of information in analyzing this case?

A. Yes.

Q. Okay. So you just don't recognize whether it was this particular specification, but you do remember looking at a specification in the production documents that HP provided for this laptop?

A. Correct. And, you know, I, you

know, and I don't -- I don't mean to be, you know, causing trouble. I mean -- but, you know, just for -- for the record, I mean, this does say "Revision 1.3."

I -- I don't know, for example, if I looked at Revision 1.3, or Revision 1.1, or Revision 1.5, if that exists. I'm -- all I'm saying is that I looked at a specification. I just can't tell you as I sit here if this -- if this is the -- the -- indeed the specific document that -- that I looked at.

Q. Okay.

A. That's all I'm saying.

Q. Understood, understood. Okay. So just as a general sense, this specification of whatever one you looked at, would be the document where HP produces a -- a set of specifications for vendors that might build batteries for them, and these are the requirements that that vendor would have to meet to get their battery pack authorized; is that a fair summary?

A. That's my understanding, yes.

Q. Okay. So if we look at this --

and I think you said that for -- for 18650 batteries, the electrical protections like overcharge, overdischarge, overvoltage, over-temperature, those are all basically more for battery performance than for safety, right?

MS. WANEMAKER: Objection to the form.

Q. I think that was your testimony.

A. Again, you -- I -- I do want to emphasize that, you know, things like repeated overcharging can cause leakage of the battery, right? The venting and leakage of the battery. That's not something we want and that can -- that can have safety implications.

Especially if the electrolyte, you know, gets on the board or it's -- if the electrolyte is flammable, so if it's exposed to a, you know, a flame or an ignition source, it can also -- those types of things, overcharge, overdischarge, things like that, can make the batteries more susceptible to, you know, external heat.

So if you're exposing the

battery to, you know, excessively high heats, if you're leaving your notebook computer, you know, on the dashboard of your car in Phoenix in the middle of the summer in the sunshine, right?

Things of that nature, you know, it can make the, you know, the battery less robust than what was initially designed from a safety perspective from, you know, exposure to, you know, misuse, abuse, you know, thing -- things of that nature, but in general, it's -- it's -- it's -- for 18650 cells, it's -- it's performance.

It's, you know, it's, you know, you don't want those CIDs to activate, because basically, the pack shuts down and the -- the consumer can't use the battery at that point. So it's generally a performance issue when it comes to -- for 18650 cells.

Q. Okay. So just so we're clear, this specification is directed to 18650 battery packs, correct?

A. Well, the six-cell battery specification for this pack would -- would be for 18650s, yes.

Q. Okay. So we're talking about 18650 batteries, so the specifications here would apply to 18650 batteries, correct?
A. Correct, yes.
Q. And -- and again, when we're talking about batteries, we're talking about battery packs, not -- not just cells, 18650 cells in a battery pack device?
A. Correct.
Q. Okay. So again, HP sets up these parameters that the vendors have to meet, and first of all, if it specifies certain fuel gauges that are required and -- and they have to use one of these -- these approved fuel gauges in the battery management system; is that how you interpret this?
A. Yes.
Q. And six of the eight fuel gauges that are approved for use in the battery management system for this particular laptop were from HP, correct?
A. Incorrect. They're from Texas Instruments.
Q. I'm sorry, from Texas

Instruments. That was a misstatement.
Six of eight are from Texas Instruments?
A. Correct.
Q. And Texas Instruments is the same company that you said was -- put out that 2005 propaganda piece to try to sell additional devices to -- to manufacturers?
A. Counselor, again, I did not say the "propaganda piece." I said that was --
Q. Marketing.
A. I said it was -- I said it was marketing material. If we -- if we could stick to --
Q. Okay.
A. -- you know, actually --
Q. So --
A. -- what I say factually, I would -- I would greatly appreciate it.
Q. But the implication you drew is that HP was trying to raise concerns that you felt were unnecessary in order to sell something?
MS. WANEMAKER: Objection to the form.

You can answer.

A. I -- I never said HP was trying to raise concerns of --

Q. I'm sorry. Texas Instruments was trying to raise potential safety concerns about counterfeit battery packs, so that they could sell authentication systems. Was that your opinion of what that marketing piece was about?

A. I never said that there were unfounded concerns. There may be certain industries where they -- where that was important. I mean, that -- that's -- I mean -- but it -- it is marketing.

So Texas Instruments designed something, they see that -- TI might see that there's -- there's -- there could be a potential problem and they -- they design something and then they market it. I mean, that's -- that's what -- that's what companies do, right?

They try to get out in front of it, you know, whether or not the, you know, different potential customers see that as a problem or are detected as a problem, that

-- that's another thing, right? So all I'm saying is that it is a marketing piece, it is a white paper. It is not peer-reviewed. It's Texas Instruments' take on it.

They clearly want to sell their product back in 2005 and -- but HP has testified and -- and I'm testifying today that back in 2005, you know, from a consumer electronic standpoint, this was not the -- the big issue with respect to battery failures.

Q. So then this specification has a number of subparts, and one of them is "Safety Functions," and -- and that's -- what it's called, right, "Safety Functions"?

A. You're --

Q. 2.5.

A. 2.6, I believe.

Q. What HP calls as safety functions, correct?

A. Section 2.6 is titled "Safety Functions" in the document, yes.

Q. And the document says, under "Safety Functions," the battery pack shall be built with the following safety

protection functions and then it lists, overcharge, discharge, over-current, over-temperature, reverse charge, cell imbalance, and short circuit protection.

That's what it says, correct?

A. Correct.

Q. Now, you -- I believe it's your opinion that none of those are really safety-related functions for 18650, because they -- those conditions aren't capable of causing fires or explosions other than in very limited circumstances, correct?

MS. WANEMAKER: Object to the form.

You can answer.

A. Yeah. So Counselor, notice that there is not a section that is performance functions. Generally, when we're -- when people are -- when specifications are made for battery packs, those specific issues, you know, the -- that are listed here, are put under the category of -- of -- of safety functions.

Again, because there isn't -- you'll notice the absence of a section in

here, the equivalent section that is performance functions. Your specific question, which was none of those, are -- are -- are safety functions.

I will go back to my original answer and say that, look, you know, a -- a cell that has had an overcharge event that has activated the CID is going to be less thermally stable when exposed to an external heat attack. It will certainly have leaked electrolyte.

There -- there are potential issues with that under the right conditions where that can be a safety issue, right? You know, if -- if you're using the -- the device in, you know, areas where, you know, it could be exposed to, you know, an ignition source or it could be exposed to extreme elevated temperatures and you don't want that, right?

So -- but those are -- those are -- generally, those are -- those are features that would be, you know, put into a section called safety functions. Again, because there is an absence of a section

called performance enhancement, performance retention, or something like that functions in the specifications. That's generally where you expect it to be.

Q. And is that something that you're familiar with from creating specifications for battery packs, that you use the word "safety" when you mean performance?

A. It's something that I'm familiar with, because I reviewed hundreds of battery pack specifications for a variety of different applications over the last 25 years.

Q. And over that 25-year period, these different devices are universally referred to as safety functions?

A. I would not necessarily say universally, because I think in things like electrical vehicles and other, you know, other, you know, very large battery packs, there are more detailed and sophisticated sections regarding performance, you know, where, you know, when you're spending, you know, a tremendous amount of money on a

battery pack and you want to make sure that it lasts for ten, 15 years, you know, you are very concerned, because, you know, the pack is extremely -- a pack is -- might be tens, or 20, or even hundreds of thousands of dollars, you know, performance and longevity is a -- is a very important part.

So you will have sections in those specifications for that, but with respect to consumer electronics, this is very standard.

Q. Right. So in your experience, all the 18650 specifications you've ever read, refers to these particular functions as safety functions, that's -- that's the parlance you've seen?

A. This is consistent with what I am familiar with, yes.

Q. Okay. And the -- 2.5 also says that the battery pack needs to have temperature sense capability; do you see that?

A. Yes.

Q. And temperature sense capability in this context means -- and we can look at

the specification later on here, that when a temperature of the battery pack gets above a certain level, the charge has to be turned off.

Are you familiar with that?

A. Generally, that is one of the -- one of the features of the temperature sensing, yes.

Q. And is it your opinion that that is entirely for performance only and not for safety?

MS. WANEMAKER: Object to the form.

You can answer.

A. There -- there -- there is a safety function of that. Again, you know, if -- so you're -- the -- again, I'm going to go back to the, you know, your car in the summertime.

It is very foreseeable that somebody may leave their electronic device in their car in the summertime, and it is very conceivable that the temperature of that car could get above 65 degrees Celsius in the summertime if it's parked in the sun.

You don't want to be charging your battery at 65 degrees Celsius, or 45 degrees Celsius, or 50 degrees Celsius under those conditions, right, and there are certainly car chargers and there are many other, you know, scenarios you can think of where the device could be at elevated temperature and you don't want to be charging, you know, putting charge into it for -- for -- for safety reasons.

So yeah. I mean, that can be under those -- in those situations, where you're -- the device is in a high temperature ambient condition, you don't want to be charging it, and there are safety reasons for this.

Q. Okay. What's -- what's the danger of a battery that is over 45 degrees Celsius that continues to charge, what's -- what's the safety risk there?

A. Generally -- and again, there -- there's -- there's, you know, there is a, you know, a safety margin there, but when you charge a battery, the battery does heat up due to -- because of the internal

resistance of the battery. It's, you know, what we generally refer to as ACIR heating. So the battery is going to heat up.

So if it's already at an elevated ambient temperature, right, and then you're heating the battery up, because you're charging it, you want to stay below that onset temperature, right? So that's the --

Q. The onset of thermal runaway?

A. No. The onset of -- the onset of self-heating of the battery, right? You want to make sure -- you want to try to stay below that. So that's -- that's the issue.

Q. The onset temperature you're talking about is the temperature where the -- the battery creates more heat spontaneously by itself. That's the onset temperature you're talking about, right?

A. The onset temperature is beginning of Stage 2 in the -- in -- was it the Yuan paper that I believe you pointed to --

Q. Sorensen.

A. Was it Sorensen? Sorry, my --

my apologies.
Q. That's okay.
A. Yeah. That's the transition from Stage 1 to Stage 2. That's the onset temperature.
Q. And so --
A. You want to stay below that.
Q. Right. So this temperature sense capability is intended to keep the battery pack from -- regardless of what caused the -- the heat to increase beyond that temperature, you want to make sure that the charge is turned off when it reaches a certain temperature, so that more energy isn't put into the battery that can then provoke it to the next phase?
A. Generally, that is correct, yes.
Q. And that would be considered a safety device, correct?
A. In that -- in -- in that instance, yes. That -- that is predominantly there. I mean, it's there for performance and safety, because when you get the battery up to 45, 50, 55 degrees Celsius, you will be permanently degrading

the performance of the battery as well. So there's a performance aspect of it, there's a safety aspect of it, yes.

Q. And are you familiar with the mechanism by which HP required the vendor that makes the battery packs of -- of -- of shutting down the charge?

A. The mechanism?

Q. In other words, so they want this -- this battery management system to shut off the charge when the temperature of the battery pack gets above a certain temperature, agreed?

A. Correct.

Q. Okay. Are you aware of how they want it shut down, in other words, whether it's a switch or whether it's a fuse?

A. I mean, I don't think it would be -- I mean, my understanding of a fuse -- again, I'm not -- not -- not an electrical engineer, but my understanding is that it would be something like a FET or something that would be resettable or -- yeah. I -- I would just want to say, I -- I don't know.

It -- it measures the

temperature. If the temperature gets above a certain part, some magic happens in the battery pack and -- and it stops charging the battery. Exactly what that electronic mechanism is --

Q. Okay.

A. Not my -- not my bailiwick, Counselor.

Q. And have you looked at the specifications for any of the fuel gauges that HP specified that could be used in this device?

A. No, I have not.

Q. So are you familiar that -- that both HP specification and the fuel gauges have two different devices, one a FET and another, a fuse, as a fail-safe, so that if the -- if the battery pack does not shut down, a fuse blows that basically disables the battery pack permanently, were you aware of that?

A. In -- in general, certainly since 2011, the IEEE standards have recommended that you have, you know, a -- a you have to have a -- you can't have a

single-point failure, you have to have, you know, a multipoint failure in -- in the system. So having -- essentially having redundancy in the safety protection circuits.

I believe that's in the most recent addition, I think it's 2011 of IEEE 1625 if I -- if I recall correctly. Exactly how that's implemented, how the redundancy is implemented, again, not my bailiwick, Counselor.

Q. Okay. But if it's a fuse and it permanently disables the battery pack so it can never be used again, that would be -- that would be a safety device in all circumstances, right? It wouldn't be to protect the battery pack, because you're disabling the battery pack?

A. I -- I -- I don't -- I'm sorry, I didn't follow you.

MS. WANEMAKER: I didn't either. Can you rephrase?

MR. SCHWARZ: Sure.

MS. WANEMAKER: Thank you.

Q. If the redundant system includes

a fuse that gets blown that permanently disables the battery pack so that it can't be used again, that would be a safety feature, not a performance feature; would you agree with that?

MS. WANEMAKER: Object to the form.

You can answer.

A. I mean, it's -- it's kind of both, right? I mean, if the fuse blows, then you're -- you're -- and you can't use the battery anymore, you have a serious performance issue. It's very similar to the CID operating.

Once the CID operates in two cells in the block, in this particular case, the battery, that -- that is essentially a fuse. The battery is disabled at that point, because you've opened the circuit to the siri strength [sic]. So yeah. I mean, it's -- it's, you know, from the consumer standpoint, from the customer standpoint, from the user standpoint, it's a performance issue.

From their standpoint, it's

like, my battery pack won't take a charge, my -- my computer won't run off my battery. That's a performance issue, you know, it's -- so I guess it's both.

Q. Okay. So I thought -- I thought you defined a performance issue as ways of preserving the performance of the battery pack by keeping the -- whatever parameter from getting to a point where it would degrade the performance of the battery pack?

A. Yeah --

Q. And so you're saying that something that would degrade the performance 100 percent and never allow it to be used again, would still be a performance and a safety device, not a strictly safety device?

A. Well, yeah. If you're the -- if you're the user and suddenly, your battery pack stops working, you will perceive that as a performance issue. That's the customer's -- that's the user perception of that, absolutely. Yeah.

Q. And you're saying that -- that's what HP would call a performance issue as well?

MS. WANEMAKER: Object to the form.

Q. HP -- HP was the author of this document and they're the ones that listed things as safety issues. So I just want to get an understanding. You said what the user would view as a performance issue.

Is it your position that HP will view a blown fuse that disables the battery pack as a performance issue and not a safety issue?

A. I am not in a position to tell you what HP thinks.

Q. Well, you interpret HP's documents --

A. Counselor, I will -- I will tell you this, however, I will tell you that I've been involved with many situations with consumer electronics where there is a lot of thought put into exactly what temperature do we activate the FET, do we blow the fuse.

We would like it, you know, in some situations to be as low as possible, gives us the biggest safety margin, but if you make it too low and the fuse is going

off, you know, too frequently at too low of a temperature, then your user is going to be highly upset about this, because they're going to have to be replacing their battery all the time. That's a performance issue from the user standpoint.

If you make it too high, you don't have enough safety margin. So there is this in between, right, where you're trying to -- you're trying to navigate that. You -- you want the user experience to be good, you want to make sure that from a safety standpoint, that you got enough -- you got enough margin to vary there.

So it's in between. Exactly how HP interprets that, you know, that's a question for HP, Counselor.

Q. I was -- I was going by their phraseology in their report -- or in their specification, but if you think that there -- HP would answer that question differently, I -- I will exceed to that.

Would you turn to Tab 5, which I've marked as Exhibit 5?

(Exhibit 5, Fire Department

Report, was received and marked for identification by the reporter.)
A. Okay. This would be Bates-number HP00398; is that correct?
Q. Yes. That's the beginning of it.
A. Yep.
Q. And it goes on -- if you could turn to the page that is the narrative part, which is HP00410.
A. 410. Okay.
Q. And this is the narrative report of the fire investigators from the Allegany County Fire Investigation Team that actually went to the scene and looked for the cause of the fire, correct?
A. This -- it appears to be, yeah -- yes. So if I go to 408, the, you know, two pages before, it's titled "Allegany County Fire Service Fire Investigation Form (short)," yes.
Q. And the next page says, "Narrative," and then the next page continues the narrative, correct?
A. Correct.

Q. And it's signed by CFC Jeff Luckey on 2-21-20?
A. Correct.
Q. And -- and this was one of the documents that you listed as the -- as one of the materials that you reviewed. So I was just going to ask you quickly: I thought that you had looked at this?
A. I -- I have looked at this. Again, you know, several months ago in preparation of my report, but yes, I looked at this.
Q. And on the -- on Page 410, you're aware that the fire investigators from the Allegany County Fire Investigation Team reached the final hypothesis that the HP battery or battery components near the battery caused the battery to overheat and explode, sending sparks and flammable material that ignited the lightweight materials in the office area of the computer cabinet or closet?
You're aware of that?
A. I am aware that that is what the Allegany Fire Department determined, yes.

Q. But in your opinion, that's impossible?

A. In my opinion, they -- they -- they are wrong, yes.

Q. Right. And so -- and you weren't ever at the scene, correct?

A. Correct.

Q. You've never looked at -- you weren't at the inspection that they did of FRT of the laptop, and its components, and the battery, correct?

A. Correct.

MS. WANEMAKER: Object to the form.

A. I -- I -- I -- I -- I've seen photographs and -- and x-ray images of the evidence.

Q. And you've never actually asked to look at the evidence that was collected from the fire, including the -- the HP laptop that was involved in the fire? You've never asked to look at that?

A. There -- there -- I -- I have not for the simple reason that, you know,

there's nothing that I could conceive of at the time that I wrote my report that -- that I would have needed to do.

I -- I think that the, you know, the evidence exam was -- that -- from the evidence -- at least from the opening reports, from the -- from Plaintiff's experts, you know, was -- was sufficient for -- to render an opinion on.

Q. So the answer is, you never -- you never asked and you never looked at that stuff, because you didn't think you needed to?

A. That --

MS. WANEMAKER: Object to the form.

You can answer.

A. Yeah. I -- there -- there was nothing in addition that -- at the time that I wrote my report that I would have wanted to look at, correct.

Q. Okay. So let's turn back then to your report -- and it's now 1:12, would you like to take a quick break and -- and eat something, and we'll come back at maybe

1:30?

MR. SCHWARZ: Jackie?

MS. WANEMAKER: That's a good idea. If -- if -- if that works for you, Doctor.

THE WITNESS: That -- that's fine.

MS. WANEMAKER: Okay.

MR. SCHWARZ: Okay. Let's go off the record.

THE VIDEOGRAPHER: The time is 1:12 p.m., going off the record.

(An off-the-record discussion was held at this time.)

THE VIDEOGRAPHER: The time is 1:30 p.m., and we're back on the record.

Q. We were just looking at -- at the Allegany fire investigator report and the -- the hypothesis -- the final hypothesis they reach, and my question was, in the notes that you looked at from Mr. Gorbett, the HP expert, did you find anything that was contradictory to what the Allegany Fire Department people reported in

their narrative?

A. I --

MS. WANEMAKER: I'm just going to make an objection to the form, but you can answer if you're able.

A. I -- I -- I -- I don't -- I don't recall, you know, again, you know, the, you know, what I would say is that it's -- it's, you know, it's not unusual for me to disagree with a fire department's initial, you know, assessment, you know, a lot of the times, fire departments are, you know, are looking at, you know, where -- where they see, you know, you know --

Q. I'm sorry, Doctor. The question I asked you, in specific, is not why you disagreed with the fire department, but whether anything in Mr. Gorbett's notes that you listed as one of the materials you reviewed -- Mr. Gorbett was the HP fire investigator on the scene, whether anything of his notes were -- were inconsistent with what you read in the narrative from the Allegany Fire Department investigator?

A. I -- I -- I don't recall.

Q. Do you remember how extensive Mr. Gorbett's notes were that you reviewed, like, whether it was one page, or ten pages, or diagrams, or --

A. My recollection was what I reviewed, photographs from Mr. Gorbett and there -- I -- as I recall, there -- there -- there may have been some photographs of some notes that he took during his scene inspection and that was -- that was the extent of it.

Q. Okay. But the photographs of the notes, did you read the -- the notes that were photographed or did you just look at the photographs?

A. I mostly was looking at the photographs and would focus on the -- the notebook computer -- the instant notebook computer issue, as well as the -- the battery debris.

Q. Now, if you turn back to your report which, is Exhibit 1, the last page, you have a "Limitations" section?

A. Yes, I'm there.

Q. And the last sentence says, if

new data becomes available or there are perceived omissions on the statements in this report regarding any aspect of those conditions, we ask that they be brought to our attention as soon as possible so that we have the opportunity to fully address them.

Did I read that correctly?

A. Yes.

Q. And is that sort of a standard ending limitation you put on all your reports?

A. It is, yes.

Q. Okay. So since the date of -- that you issued this report, which I believe was December of 2024, if I'm correct, yeah, December 2, 2024. Since that time, have you discovered new information that you wish to make any alterations or corrections in any of the facts that you've listed in this report?

A. None of the facts that I've -- I've issued -- that I listed in the report. I mean, certainly, there were some issues that were brought up in the rebuttal reports from, you know, especially with respect to

Professor Martin that I have issue with and disagree with, but I don't -- but none of those would call me to change any of the opinions in my report.

Q. And what I was really asking about is, did your -- so there's nothing that you learned factually since the report was issued that's different than the -- the facts you assumed to be true at the time you wrote the report?

A. Correct.

Q. Okay. All right. Let's then take a look at Page 13 of your report. Let's start there.

A. Okay.

Q. So on Page 13, you begin to talk about the inspections that occurred that you didn't attend, correct?

A. Correct.

Q. And the first inspection was the February 27, 2020 inspection, where Mr. Gorbett on behalf of HP and all of these other individuals went to the actual scene of the fire, which was approximately a month after the fire?

A. That's my understanding, yes.
Q. And where did you get that information; if you recall? From Mr. Gorbett's notes?
A. I -- I don't recall. I -- I believe that that was information that was provided to me by -- from -- from counsel for HP.
Q. So who was at the -- the examination was provided to you, do you think by the attorneys for HP?
A. Yes, and as well as the date of the inspection. Yes.
Q. And so the -- there was a -- it appears to be, there were investigators from two -- different investigators from Farmers Insurance, two investigators from Staples, the two FRT technology investigators, and the attorney from my office, and then Mr. Gorbett of HP, who is with a company called Fire Dynamics Analis -- Analysis, excuse me, and then Mr. Luckey, who was the author of the Allegany fire investigator report.
All those people were on the

scene there on February 20th according to your report and the information you were provided, correct?

A. Correct.

Q. And then below that -- oh, and then -- it indicated also that a 3D Matterport, M-A-T-T-E-R-P-O-R-T, scan was created. Did you review that?

A. I did not.

Q. Okay. And then the -- the next section indicates that on October 27, 2020, a lab exam occurred and then you list all the people that were at the lab exam, correct?

A. Correct.

Q. And was it your understanding that the lab exam was an examination of materials that were removed from the scene on February 27, 2020?

A. That was my understanding, yes.

Q. And what was your understanding of how the -- the items that were chosen to be examined in the laboratory were chosen?

A. My understanding was that there were, you know, different items that were

found in the -- what was assumed to be, or, you know, the area of origin and that those were the items that were identified in the previous lab exam -- or in the previous scene exam that should be examined in more detail.

Q. And on behalf of HP then, Mr. Galler was present for the lab exam of the materials that were chosen by the group that included Mr. Gorbett?

A. That's my understanding.

Q. Was there any -- any item that you felt should have been examined in the laboratory, but wasn't brought back to the FRT based upon your review of the case?

A. At the time I wrote the report, no.

Q. What about now?

A. There -- there was a -- it's identified in Karasinski's rebuttal report, you know, there's a photo that he claims is a remnant of one of the batteries that was collected from debris from the closet in the office at the scene.

He -- he claims that that is a

remnant of the -- of one of the cells that expelled its contents that was found in the closet and that that is what initiated the fire, and I believe he says in his deposition that that was a -- a full electrode assembly from -- from one of the cells.

That -- that -- that specific piece of evidence, I don't believe was examined, in the October 27, 2020 examination and seems like that may have been a -- a critical piece of -- of evidence that -- that -- that should have been examined.

Especially if -- if that is what -- he has claimed to have been from the battery from the -- from a cell from the instant computer that made its way to the closet and initiated the fire in the closet.

Q. Okay. So you used the word "claims" several times. Is it your -- is your testimony that you don't believe that any remnants of the battery interior cells were found in the closet?

A. I certainly haven't seen any --

any evidence that would -- that would support that there were any -- any -- any evidence of the batteries that were found in the -- in the closet.

Q. Including the pictures of the -- the contents that were taken from the closet?

A. Correct. Not -- none -- none of that evidence to my knowledge has -- has been subjected to any -- any kind of photo documentation, measurements, characterization that would confirm that that was evidence of -- of a battery from -- evidence of material expelled from the -- from the instant battery pack.

Q. And so did you check with Mr. Gorbett, because Mr. Karasinski says in his report and at his deposition that all of the investigators that were there on February 27, 2020 were part of the examination of the materials taken out of the closet when this piece of battery was found?

Did you talk to Mr. Gorbett to confirm your suspicion that that's not true?

MS. WANEMAKER: Object to the form.

You can answer.

A. Yeah. I -- I've never spoken to -- to Mr. Gorbett and -- and that particular piece, the -- the only -- the only photo of anything that has been claimed to be part of the instant battery was -- was a part of Karasinski's rebuttal report. So that was not ever shown or analyzed in the evidence that was examined in October of 2020.

So at the time I wrote the report and until I saw Karasinski's rebuttal report, I was not aware of anybody claiming that there was any battery material that was found in the closet.

Q. All right. So it's your understanding that Mr. Gorbett is still alive?

A. I've never spoken to Mr. Gorbett. I -- I hope he's doing well.

Q. Okay. Well, if he is doing well and it's our understanding that he's -- he's doing well and fine, your use of the word "claim" with regard to what Mr. Karasinski

said would be easily checked by checking with Mr. Gorbett to see if he witnessed that piece of evidence being taken out of the closet, right?

Then you can take the word "claim" out of it and you would know that that was found in the closet?

MS. WANEMAKER: Object to the form.

A. I -- I -- I --- I mean, I would have to assume that if a piece of evidence was found in the closet, that that would have been a critical -- and -- and the closet is what the fire investigators have assigned as the area of origin, that that piece of evidence would have been included in the October 27th -- if you know, inspection.

My understanding is that that was not, and at the time I wrote the report and until I saw Karasinski's rebuttal report, I -- I had not seen - I -- that -- that was all brand new information to me. I would have assumed that if that was a critical piece of evidence that was found at

the inspection and Mr. Karasinski thought that that was critical and could have been an initiation in the closet, that that would have been subjected to extensive analysis at the October 2020 examination, and --

Q. So --

A. -- for whatever reason, it wasn't. All I have seen is a blurry photo --

Q. Keep going. Just keep going. Just tell me when you're going to be done and then we can go back to questions.

A. All I've seen is a blurry photo of something that Karasinski says is a piece of battery that has not been subjected to my knowledge to any other laboratory examination. That's all -- as I sit here today, that's all I can tell you.

Q. All right. And that was my question, is: If you have such questions, you've learned this since Mr. Karasinski's report.

Have you asked the HP attorneys to talk to Mr. Gorbett to verify that that piece was found in the closet?

A. I have not.

Q. So you would -- you're relying on your assumption of what would be and what wasn't done, but you didn't go to the source of information that would tell you definitively whether that piece was found in the closet?

MS. WANEMAKER: Object to the form.

A. All I can -- all I can refer to is what Karasinski says in his opening report, where that was not a piece of evidence that was ever mentioned. It was only mentioned at -- his rebuttal report and that was not analyzed to my understanding at the October inspection.

Q. Okay. When you say all you can refer to, did HP's attorney say that you couldn't talk to Mr. Gorbett to verify that fact, as you're saying you've been prohibited from referring to anything, but your assumptions about what should have or would have been done?

MS. WANEMAKER: I don't want to get into any privileged territory as

to what discussions -- what -- please note my objection to this question.

MR. SCHWARZ: I mean, if you want to say that -- that he was instructed to do something by the attorneys, that he couldn't talk to Mr. Gorbett, then I won't ask him any more questions if that's the -- the instruction, Jackie.

MS. WANEMAKER: No. That's -- that's not what I'm saying. I just -- I don't want to get into any potentially privileged territory, and also object to the form of your question.

MR. SCHWARZ: Okay.

Q. So I think that means you can answer it.

Were you prohibited from talking to Mr. Gorbett to verify what was in Mr. Karasinski's rebuttal report that you're saying you don't believe?

A. I was not -- I did not ask, nor was I -- was I told that I was prohibited.

Q. So you chose instead to assume

that that piece wasn't found in the closet?

MS. WANEMAKER: Objection to the form.

You can answer.

A. No, no, no, Counselor. That -- that -- that is not what I have chosen. What -- all I can do is look at what has been provided by Plaintiff's experts, and Plaintiff's expert in the opening report -- in his opening report never pointed to any piece of battery that he claimed was found in the closet.

All of the battery pieces that were analyzed, that were -- that were collected from the February scene inspection and analyzed in the October 2020 inspection were collected from the office area, not from the closet. That's my understanding.

They were tagged, there was a map of the room, they were -- there were -- there was indications and photo documentation, as well as schematics of where those components were found at that October inspection. There were -- there was nothing that was claimed to be found in the

closet.

The only thing I have seen is a blurry photo in Karasinski's rebuttal report that shows what he claims is a component from the instant battery with no proof, no analysis, no anything on -- on, you know, showing what exactly that is. That's all I can say.

Q. Okay. So that's what I'm trying to get at. So that's all you can say from the initial report. Then you got a subsequent report that provided information that a piece of the battery was found inside the battery pack. In your initial -- I'm sorry, withdraw that question.

In your initial report, you assumed that no battery interior components were found in the closet, correct?

A. I don't want to say I assumed it. What I -- all I can tell you is that there were no battery components at the time I wrote my report --

Q. All right. All right. Let me -- I'm going to withdraw the question. I'm going to withdraw the question.

In coming to your opinion, did you base your opinion on the fact based upon how you understood the facts that no battery components were found in the closet?

A. Correct.

Q. Okay. Now you have learned that Mr. Karasinski, who was there at the scene along with the other eight people that you listed here on this page, says, indeed a piece of the battery interior component was found in the closet, and you said that in light of that or in spite of that, your opinion remains that no battery materials were found in the closet, correct?

A. My --

MS. WANEMAKER: Object to the form.

You can answer if you're able.

Q. In other words, did you -- did you change your assessment of the facts based upon the evidence that Mr. Karasinski presented, and I think the answer is no, right?

A. You've doubled-up on the questions. Can I go back to the first one?

Q. Not if it's going to be a 20-minute answer, but in other words, I'm trying to get at, you had a certain set of facts that you used to come to your conclusion in your -- in your report, correct?

A. Correct.

Q. And one of those facts was that there were no battery components found in the closet?

A. Correct.

Q. Okay. Subsequent to you writing your report, Mr. Karasinski has presented evidence that, at least his testimony, and his photograph, and his report, that battery components were found in the closet, correct?

A. That's what he claims. They are --

Q. Yes.

A. -- unsubstantiated.

Q. Okay. And so because you believe they're unsubstantiated, did you therefore -- do you continue now to -- to believe that no components were found in the

closet?
A. All I can say is that there have not been any -- any components from the instant battery that have been confirmed to have been found in the closet.
Q. Okay. And as a result of that, your opinion is based on the -- the assumption or fact, in your view, that there were no components found in the closet?
A. There have been no components that have been -- there have been no -- there has been no evidence extracted from the closet to my knowledge that have been confirmed to have been from the instant battery pack.
Q. Okay. Now, the -- Mr. Gorbett, on behalf of HP, was present at the time that Mr. Karasinski claims that he found -- he and the other investigators that were there, found the piece of the battery inside the closet; you're aware of that?
MS. WANEMAKER: Object to the form.
A. I -- the way that you're -- the question is phrased is that you're asking me

if Mr. Gorbett was present when Mr. Karasinski claims he found evidence of the battery in the closet, and I -- I -- I -- my understanding is that Mr. Karasinski didn't claim to have found evidence of the battery in the closet until after I submitted my opening report and he wrote his rebuttal report.

Q. I guess that's what I'm getting at. In other words, instead of you having to assume whether there was a piece of battery in the closet or not, Mr. Gorbett, who is an HP representative, was present and you could ask him, and that way, there would be no question in your mind whether Mr. Karasinski is telling the truth or not and whether you can accept Mr. Karasinski's representation or not, and you haven't done that, right?

MS. WANEMAKER: Object to the form.

You can answer.

A. Counselor, I -- I have to -- I'm -- you -- you're implying that -- you -- you -- and we can have the court reporter go

back and -- and -- and state this, but you're -- you just said that I'm implying that Mr. Karasinski is not being truthful, and that is -- that's a complete mischaracterization of -- of my testimony. I am not saying that.

All I am saying -- that, you know, I would -- I would suspect that Mr. Karasinski, if -- if indeed that was evidence that was found from the closet, that that would have been analyzed in October 2020 and not brought to our attention, you know, four to five years later after my report was issued. If that is indeed the quote, unquote, smoking gun.

If that was what caused -- initiated the fire in the closet -- and that was found back in February 2020. I don't understand why five years later, the first time we've heard of it is in his rebuttal report. All I'm saying is that from my perspective, I have to look at the facts of the case and the evidence, and the confirmed evidence that has been analyzed at the October 2020 inspection was on materials

that were found from the office.

No evidence, and to my knowledge, was analyzed at that inspection that was purportedly from the instant battery, came from the closet. The first that we've learned of that is five years later.

That's all I can say. So there's a blurry picture of something that Mr. Karasinski says five years later is from the battery pack, right? That has not been analyzed. There has been no subsequent photos, there has been no analysis of that -- that -- similar to what was done on the debris that was found from the office area, and that's what I have to base my opinion on.

Q. Okay. I -- you haven't answered my question and we'll move on. My question was: If you -- if you have issues with whether a piece was found in the closet. There were nine other witnesses there when that piece was extracted and you've chosen not to contact the person from HP who witnessed it being retrieved from the

closet.

You've chosen instead to decide that, because you only learned of this now, it can't be true, right?

A. That is incorrect, and that misrepresents my --

Q. Okay. Then we'll move on. If that's a misrepresentation, we'll move on. I think the -- the testimony will speak for itself.

And you didn't look in Mr. Gorbett's notes to see if he noted anything in his notes about a piece of the battery being found in the closet?

A. I -- I certainly don't recall seeing anything in Mr. Gorbett's notes that indicated there was a piece of battery found in the closet.

Q. And do you have Mr. Gorbett's notes available that you could look at now to see if there's anything in there?

A. I -- I do not. I'm -- I'm taking this deposition from my home office. I don't have my -- my complete file here.

Q. Well --

A. Unless -- unless perhaps they're in the binder -- in this binder and you can point me to them.

Q. Well, you -- well, I haven't seen Mr. Gorbett's notes. That's why I ask you about it, because they haven't been produced to us, but they seem to be highly relevant here to see if the things that you're questioning as evidence was actually contained in Mr. Gorbett's notes.

So I think without question, we should get them now; don't you think?

A. I think you should probably ask Mr. Karasinski why he didn't select that piece of material that was found in what he claims is the area of origin and he claims is part of the battery, why he didn't select that as part of the evidence exam in 2020.

From my perspective, it would imply to me, at least, that at the time, he didn't feel that that was an important piece of evidence. So I would -- rather than ask Mr. Gorbett, I would prefer to ask Mr. Karasinski.

Q. Okay. Let me ask you this

question: What -- what leads you to the conclusion that the battery windings that were taken as evidence didn't include that piece?

A. Because I haven't seen -- my -- my -- the photos that I have seen and from the October 27, 2020 inspection did not include that piece.

Q. Okay. And how do you know that?

A. Because the evidence that was -- that was at the inspection was -- there are photos of the office scene. All of the evidence was tagged, labeled with respect to the location it was found in the office, and that's what was removed and examined at the inspection.

There was no evidence that I saw from any of the inspection photos that was removed from the closet that was -- that was claimed to be part of the battery.

Q. So you weren't present at the inspection at the house and you weren't present at the inspection at the laboratory, but you've been able to tell from photographs that what was inspected in a

laboratory was not the piece of winding that was in the closet?

A. Correct.

Q. Okay. And you wouldn't be interested in asking Mr. Gorbett what his recollection was and whether anything was found in the closet or why Mr. Gorbett didn't choose other evidence to bring to the laboratory? That is not something that you would be interested in?

A. No. I would be more interested in asking Mr. Karasinski about -- why, you know, five years after the inspection, he would show a blurry photograph and claim that that was a piece of evidence that is critical to the case, but yet he did not select that for inspection at the evidence.

That would be the question -- that's the person I would want to ask, and talk to, and understand what that -- what his -- his thinking was there.

Q. So do you believe then that -- that Mr. Karasinski was the only fire inspector that was on the scene on February 20th that was interested in the

cause and origin of the fire?
A. I --
Q. Well, you keep saying that you would ask --
A. No, sir --
Q. -- Karasinski why he didn't do something when there were nine other people that were also there that could have done exactly the same thing that you don't want to ask, including the HP representative.
A. Because Mr. Karasinski is the only person who is claiming that there is a piece of the battery that was found in the closet.
Q. Did you see Mr. Gorbett's report of his -- his findings of the cause and origin of the fire?
A. I believe that I -- yes, I have.
Q. And what was the cause and origin of the fire according to Mr. Gorbett?
A. I believe he pointed to the closet -- to the closet as the -- as the origin of the fire.
Q. And do you believe he also pointed to the HP laptop as the cause of the

-- the ignition source for the closet for the fire?

A. I -- I don't recall.

Q. And Mr. Gorbett was HP's representative on the scene, who actually did the investigation to determine the cause and origin, correct?

A. My understanding is that Mr. Gorbett was HP's representative on the scene, yes.

Q. Okay. All right. On Page 15 of your report, make sure I'm on the right page. Yeah. You've got -- Figure 4, you've got the photographs of the laptop and the armoire shelf where the laptop was found, correct?

A. Correct.

Q. And then you describe in the last sentence on that page, you say, both cell cans have de-crimped and ejected their internal windings, and some of these windings were found nearby the cells, and I believe you're talking about the two cells that were not in the computer and the two cells that were -- were intact, but the two

cells that were empty; is that what you're referring to?

A. What I'm referring to there is the cell cans and the internal windings from those cell cans, found nearby the cell cans. Maybe I should have said cell cans, but yes.

Q. Okay. But -- but in any event, just to -- later on, we'll go through it in your report, but there basically were -- were three groups of cells of the six, right?

There were two that -- that didn't go into thermal runaway that were fused together and were found on the floor, there were two that ruptured and exploded that were found in the laptop, and then there were two empty cans that had ejected their contents, and that's what you're referring to at that last pair, the two empty cans here?

A. Correct.

Q. Okay. That's what I want to get at, and you said -- the next sentence, you said, there was no thermal damage or ignition of the carpet?

A. Where the cells were observed, correct.
Q. So -- and you base that on your observations of photographs, did you?
A. Yes.
Q. Okay. Take a look at Tab 12, which we'll mark as Exhibit 6, which is Mr. Litzinger's report.
(Exhibit 6, Mr. Litzinger's Report, was received and marked for identification by the reporter.)
A. Okay.
Q. And specifically on Page 15, Figure 21.
A. Okay.
Q. Now, Mr. Litzinger testified and represented that -- let me find that -- yeah. On Page 15, you'll see there's a can on a piece of carpet.
A. Correct.
Q. And you see that there's black char near the top of that can and sort of a diagonal line that goes off the photograph?
A. I -- I see that there is some black residue on the carpet. Whether that's

-- I don't -- I mean, char or not. I mean, there's char all over the room. So -- so yeah. I mean, I see that there's -- there's some black on the carpet.

Q. And -- and how did you determine that that wasn't char as Mr. Litzinger indicated it was, which would be evidence of thermal damage to the carpet in the area of where this can was? How did you make that determination?

A. I make that determination, because the can itself has -- has basically no heat. So the can has expelled its contents. The contents of the -- of the cell is the fuel, that's what's generating the heat.

What you have is an empty can that is almost instantaneously cooled as it flies through the room, and so the can is not hot. When you have a thermal event that causes a cell to expel its contents, the can itself is not just generating heat. It's the contents of the cell that are reacting.

So the can is not hot, and that's evidence by the fact that, you know,

that at least one of the cans still has, you know, that has ruptured, still has part of its label on. So the can itself does not get hot or it doesn't get very hot when it expels its contents. So the can itself is not really an ignition source.

Q. So the -- this can wound up across the room, correct?

A. Well, it's -- it separate -- yes. It expelled itself -- ejected itself from the computer, correct.

Q. Right. And it traveled somewhere in the vicinity of ten to 15 feet?

A. I -- I'm sorry, I -- I don't know exactly how far it fell. I mean, I think in my report, there is a -- there's a schematic of the room, you know, and where -- where that particular can was found and probably make a measurement on exactly how far it was, you know, from the computer. Several feet, I believe.

Q. What -- what -- what was the energy source that propelled it to travel on its own out of the battery component -- out of the battery compartment across the room?

A. Gas generation within the -- within the cell.
Q. And you're saying that in your experience -- and when -- a gas generation would be sort of an explosive event, right?
A. It's -- it's an overpressurization event of the can, yes.
Q. And that would -- when it releases its contents, it would be a reactionary force that would propel the can in the opposite direction?
A. Yes. Generally, that -- that is what happens, yes.
Q. And so the force of -- and you told me, I think, that thermal runaway can -- reactions can run somewhere in the 600 Celsius range, which is over 1,000 degrees Fahrenheit, right?
A. Correct.
Q. So it's your testimony that an explosion of the cell contents propelled the can that was somewhere over 1,000 degrees Fahrenheit, and when it went five or ten feet, by the time it landed, it had cooled, so that there would be no heat that would

char the carpet?
A. To be more specific, cell cans, when they -- when -- when the cell does not expel its contents during a thermal runaway event, the can itself can get red hot, right, because the fuel -- the -- the -- the chemical energy that is resulting in the heat is heating up the can, but when the cell can actually expels the contents, the can itself doesn't actually get very hot.
Q. Okay. So let me get this straight. So you're saying that -- this -- this is made out of what kind of metal?
A. The can?
Q. Yeah.
A. Battery grade steel, nickel-plated.
Q. So the steel can contains contents that were over 1,000 degrees Fahrenheit?
A. Briefly, yeah. I mean, well -- brief -- could be briefly.
Q. Okay. But when they got to 1,000 degrees Fahrenheit, they didn't get there from ten degrees, they went gradually

to 1,000 degrees or -- or actually, they went through the other degrees before they got to 1,000, right?

A. So try -- try to -- try to explain this. What -- when -- when a cell expels its contents because of rapid pressure buildup, the contents are not necessarily 1,000 degrees Fahrenheit at that point, right? It's -- the reaction is generating gas very rapidly, and it can expel its contents before the can -- before those contents actually complete their reaction.

So when we're talking about temperatures within the cell approaching, you know, above 660 degrees Celsius, you know, up to 1,000 degrees or slightly less, you know, 800ish degrees Celsius within -- that's when the contents stay within the can.

When they are ejected from the can, especially when they're ejected, and basically, the contents sort of turn into confetti, then you don't see temperature as -- as high, because basically, all the

chemicals that are trying to react together, they kind of come apart and they spread throughout the -- the area, and the can itself does not get that hot.

When it expels the contents, the can doesn't get as hot as what it would if the contents stayed inside the can.

Q. So you think while that was going on, while that explosion was going on, you can touch the outside of the can, you would have no damage to the skin, because it would be cool to the touch?

A. You're talking about -- thermal -- thermal necrosity [sic] of the -- of your -- of your skin and that occurs at temperatures that are much, much lower than what we're talking about here.

I think the important point on that photo is that there's no indication that there was melted carpet contacting the surface. There's no -- carpet is -- the carpet is a polymer, it's a plastic. If the can was hot when it landed on the carpet, the carpet would have been melted and stuck to the cell -- to the can, and there's no

photographic documentation that that's the case. The -- the can itself was not melted into the carpet, right? So you --

Q. What --

A. -- right, so -- if -- if -- if -- if the cell can was hot enough to char the carpet, it would certainly be hot enough to melt the carpet, right?

Q. Isn't -- isn't the char on the carpet equivalent to a melting of the carpet in the area where the char is?

A. No. The carpet will melt long before it actually begins to decompose and char.

Q. And what -- what was the -- the material that the carpet was made out of and what type of fire retardant was used on the that?

A. I -- I --

MS. WANEMAKER: Object to the form.

A. All I can tell you is that if it's -- it's most likely a polymer carpet, and that's what most carpets are made out of. Unless it was wool, but, you know, my

expectation would be that, normally, what you see is, you see melting and adhesion of the polymer fibers to a can in a hot -- in a hot battery when it hits the carpet, and if it is sufficiently hot, then you may get charring, but the melting happens first.

That's, you know, if you look at any polymer, you're going to get melting, and then at a higher temperature, you're going to get charring. So --

Q. Were you able to view the carpet underneath the -- the can to see if there was any melting?

A. Well, I -- I -- what I -- what I don't see from any of the photos of the can removed, is adhesion of carpet or fibers to the -- to the can. So it's -- this is -- this is not -- this is very consistent with -- with battery science.

When you eject the contents from the can, it happens very, very quickly. The can does not actually get that hot, because the fuel is leaving the cell can. Now, if the fuel stays within the cell can, then the can can get extremely hot. It can get red

hot, it can get well-above 660 degrees Celsius.

That's different, but when it expels its contents, it's expelled the fuel, as well as the vast majority of its thermal mass. You have less than ten percent of the thermal mass in the can itself. So it's going to cool very rapidly, and it's not a surprise that the can -- the can would not be an ignition source.

Q. No one -- no one said it was, no one said it was, and just so I'm -- I'm clear, I -- I think I understand, but you're not saying that before the can expels its contents, the can would be some fraction of the temperature of the internal components, like, some small fraction, like, it'd be kind of cool, but the inside would be three, four, 500 degrees Celsius?

A. Generally, when you are heating a -- a 18650 cell up from an external heat source, obviously, you know, the can itself is going to get to, you know, around, you know, before -- at the point where you have a thermal event. The can itself is going to

be -- is being heated from an external source.

At the point where you get a thermal event, that's when the internal chemistry starts to take over and you start getting inside-out heating. In the situations where you expel the contents, that inside-out heating doesn't have a chance to really get the can itself higher than what the external heating has -- has caused the can to get.

So the can, at the point when it expelled its contents, is probably going to be right around 185 to 200 degrees Celsius-ish, right in that -- right in that vicinity, but it expels the contents. So it's not going to get really any hotter than that, because, again, there's no other heat source, right?

It's -- it's been blown away from the computer, it's now on the -- on the carpet. That's a cool location, and the can's going to cool very rapidly, because it has very little thermal mass.

Q. And is that based upon your

experiments in causing thermal runaway from external heating sources?

A. In part, absolutely.

Q. Okay. What is your basis of saying that that's the same temperature would be if the thermal runaway that happened from internal heating alone and without an external source, would it be different in that circumstance or the same?

A. It would be different in that circumstance, because when you have an internal source, like an internal cell defect, then the cell does not expel its internal contents, and in that situation, the can does get -- can get very, very hot, you know, almost as hot as the inside of the cell.

So again, there are -- I've certainly seen situations where, because of an internal cell fault, the can itself can reach temperatures that you can actually see, you know, it becomes -- starts to become red hot. You can actually see that. So in those --

Q. In those -- in those

circumstances, I understand that the cell can never expel its contents; in your experience?

A. The cells -- cells are -- 18650 cells are designed and -- and tested and designed to not expel contents when they fail due to internal cell defects.

Q. So that would be -- yeah. Based upon your analysis, that has never happened and it's impossible and that proves your theory that it must have been an external source, because if it was an internal source, there could be no battery components anywhere -- or internal components anywhere, they would all still be in the cells?

MS. WANEMAKER: Object to the form.

You can answer if you're able.

A. Based -- based on, you know, 25 years of testing of -- of -- of 18 -- 18650 and other lithium ion cells. Everything that we see here is consistent with that, and not only that, I mean, we don't -- we don't look at any one piece of evidence in a vacuum, right?

We're looking at the fact that it wasn't just one, but two cells that de-crimped and two cells that -- that ruptured. So we've got four cells that have had rupturing events out of six. What that indicates is that this is not an internal cell defect.

That is an external heat applied to the battery pack that is causing the cells to very rapidly go into thermal runaway, generate gas that overwhelms the vent, causes the can to failure -- fail, and not just one cell, but in four of the six cells in the battery pack.

Q. In your theory, all six cells were exposed to exactly the same thermal heat source, right?

A. Well, all six cells would been in the computer at the time that the fire, you know, encroached on the -- the heat from the fire encroached on the computer.

Q. Right. So all six cells -- all six cells were exposed to the same external heat source under your theory, but only four of them went into thermal runaway and the

other two were completely intact?

A. Yeah, and -- and that's consistent, right, because one -- I mean, one cell has to go off first, right? I mean, one has to go first. Even if, you know, the best laboratory conditions and you put the cells in an oven or the -- a constant radiating heat source, they're not all going to go off instantaneously, right?

One's going to be a little bit hotter, one's going to go off first. Now, in the event that you have expulsion, what happened -- what happened in this case is that the first cells that went, blew out the -- the two cells that were found that didn't have a thermal event, blew them to a part of the room that was cooler.

So those cells had not gone into the Stage 3. They were still in Stage 2, and so they went to a cooler location. They were able to cool down, they didn't go into thermal runaway. That's very consistent with what we saw when we have cells being expelled from the pack before they actually reach that critical temperature.

Q. And just so I know, can you give me any references that support your contention that internal causes of thermal runaway never result in expulsion of the internal cell material?

A. Again, I'll -- I'll point you to the standards that I referenced, right, which is -- which is --

Q. In the standard, it says that?

A. In the standards, the -- the important point of the standards is that all of the tests that are conducted in the standards require that the cells do not expel their internal contents, except when exposed to an external heat source, such as flame impingement.

In which case, the cells can expel their internal contents and still pass the standards, right? What that tells you is that -- and the standards subject cells to overcharge, overdischarge, over-current, all kinds of testing, right? They can't -- and under those conditions, expel their contents, unless they're exposed to a fire, and now when they're exposed to a fire, they

can pass the standards and -- and still expel their contents.

So that right there tells you that the industry-accepted behavior of 18650 lithium ion cells is that if they have an internal fault, they don't expel their contents. If they're exposed to a fire, they can expel their internal contents.

Q. And I misunderstood the testimony of a prior witness, because I thought that the standard required the -- the cells to be exposed to something like 130 degrees Celsius.

Are you saying that the standards require them to be exposed to the 200-degrees Celsius temperature that would -- would go into Phase -- Phase 3 of thermal runaway, is that the standard you're talking about?

A. You -- if you look at the UL standards, there is an oven test that exposes the cell for a brief period of time at 130 degrees Celsius, and in addition to that, there's a test called the projectile test, which exposes the cell to an external

flame.
Q. So --
A. So I don't know who -- which -- which expert you were talking to, but --
Q. Okay.
A. -- you'd have to look. The standards have many, many different tests.
Q. Yes.
A. The external flame is part of those tests, yes.
Q. Okay.
A. And -- and that -- that test does -- and if you read the standard, it does stipulate that an explosion may occur and that, you know, proper safety conditions, including hearing protection and things need to be employed, because when these cells expel their contents, it's loud.
It's like a gunshot going off. When they expel their contents from a computer and -- and shoot through a computer, that is a very loud event. So -- and it's very energetic, so you have to have the appropriate safety precautions in place to make sure that, you know, nobody gets

hurt while you're doing those types of tests.

Q. Now, I'm going to ask my question now and see if you can answer. I'm not talking about the flame, I'm talking about without a flame, the highest temperature the standard requires the batteries to be exposed to is 130 degrees; is that correct?

A. Yeah. That's the oven test, correct.

Q. Yes. And -- and you just said too, that that 130-degree temperature is only for a brief period of time?

A. Correct, yes. It used to --

Q. You're saying that --

A. It used --

Q. Let me -- go ahead, go ahead.

A. No. It used to be 150, but it's been brought down to 130, you know, maybe around 2005ish timeframe.

Q. Okay. So as I understand it then, you're saying that the fact that a cell doesn't go into thermal runaway when exposed to an external heat of 130 degrees

Celsius for a brief period of time, is your proof that internal defects in a battery that cause thermal runaway, never causes explosion of the internal components of the battery, only -- only the flame would do that, you're saying?

A. Yeah. Only when you heat the cell externally up to the thermal runaway point -- only when you heat the cell up to the thermal runaway point from an external heating source.

So you -- so you have to heat it up to, you know, 185, 180 plus from an external heat source in order to possibly, not -- and again, it's a bit stochastic. So not every cell is going to expel its contents when you heat it up that high, but there's a possibility that when you heat it up to the thermal runaway condition via an external heat source, that it can expel its contents.

Q. Right. But -- but the point was that, I asked you for references as to your absolute statement that an internal cause of thermal runaway never causes explosion of

the battery contents, and you pointed me to the UL standard that requires from an external force -- external heat for a brief period of time at 130 degrees, and is that part of the test that you're saying shows you that it -- it can't expel its contents from internal heat alone, it has to be external heat, is that -- is that your proof of that?

I'm just trying to get it clear.

MS. WANEMAKER: Object to the form.

You can answer.

A. It's the totality of the testing that is incorporated --

Q. Okay. So we know one test now -- okay. So the one test that you've mentioned is the proof of your theorem that internal cell defects causing thermal runaway can cause ejection of the contents. One part is the 130 degrees brief period of time, external source test.

Now, you said there's a totality, so tell me what else you're relying on from the UL standard that gives

you confidence that you can make this statement that the type of ejection that happened here could never happen from an internal thermal runaway event.

What else is there other than what you've told me already about the flame test and of the oven test, what else?

MS. WANEMAKER: Objection to the form.

You can answer.

A. I don't have U -- the -- the UL testing memorized as far as every single test, but there are multiple tests that are part of the UL safety standards for -- for -- for lithium ion cells.

They -- which subject the cells to various different conditions, overcharge, overdischarge, the oven test, and additional types of testing, and the requirement in all of those tests is that the cells do not expel their contents, right? That's -- that's the -- that's the foundation, right?

We don't want the can to expel its contents, we don't want the can to have a crimp release or rupture, right, except

when it explode -- expose it to a fire. That --

Q. Let me -- let me -- can I -- can I just break this down, because I know you like to go on for a long time, but I want to try to be as concise as possible.

So you're saying that in addition to the test that you told me about with the flame and with the oven, there are other tests where they expose the -- the -- the battery cells to overcharge, and are you saying that they expose them to overcharge to the point that they go into thermal runaway?

A. No. They expose the cell to overcharge under, you know, for -- under the conditions of the test, and if the cell expels its contents, it fails. Again --

Q. I'm sorry --

A. The point is that --

Q. No. That's -- that's not the point. What I'm asking you is, is the -- is the design of the test to -- to expose the cell to overcharge to the extent it causes thermal runaway?

A. The design of the test is to expose the cell to various different misuse and abuse conditions to show that the cell will not, you know, explode.

Q. And wouldn't it depend then on the extent of the overcharge and overvoltage? In other words, do they -- do they -- are they setting it at a overcharge level that they know will cause thermal runaway in most cells or are they setting it to an overcharge situation that is above the normal operating range, but below where you would expect thermal runaway to occur?

What is your understanding of that?

A. You're -- you're -- for 18650 cells, unless you are charging them at a very high rate, higher than what is specified, the cells are not going to go into thermal runaway.

Q. Okay. I'm sorry. We're not talking about what your opinion of 18650 cells -- we're talking about the UL standard that you pointed me to, okay? You told me that you're relying on the UL standard as

your proof of your support for your opinion of a certain condition cannot occur from internal thermal runaway.

So now we're just talking about the UL, not everything else you want to talk about. The UL standard for overcharge testing, what extent of overcharge is specified that the cell has to withstand; do you know?

A. Off the top of my head, I don't have that committed to memory. So no, I -- I -- I can't answer that question off the top of my head.

Q. Okay. And when was the last time you looked at the UL standard and compared it to any test of cells that were put into internal runaway -- internal thermal runaway by overcharge?

A. I -- I -- I can't recall when the last time I -- I -- I reviewed that section of the UL standard.

Q. So you have no idea of what the literature shows is a sufficient amount of overcharge to cause thermal runaway -- thermal runaway, and you have no idea what

-- whether the temperature or the -- the overcharge that's in the UL standard is equal to that or less than that?

A. You're asking me --

MS. WANEMAKER: Objection.

A. -- specific questions and asking me to recite specific numbers from -- from memory from an extensive standard, and as I sit here right now during this deposition, I don't have those numbers committed to memory. I'm sorry, Counselor. I would have to review the standard.

Q. Well, I thought that you did review the standards in order to come to your report, because you listed them in the materials you reviewed; do you remember that?

A. Counselor, I did not commit the entire standard to memory.

Q. Got it. Okay. Now, we'll move on. So if you could turn to Page 19 of your report, and at the bottom of Page 19, you describe what you -- in other words, you call each cell a different number.

Those are numbers that you

decided to apply to them, right, or are those cells -- are those numbers that were somehow, you know, designated in the battery management -- or the battery system?

A. As I recall, Counselor, those were numbers that were assigned by somebody, and I don't -- and I was trying to be consistent. I don't recall off the top of my head who initially assigned, like, Cells 1 and Cell 2 to Item 1, Cell 3, Cell 4 -- called them Cell 3, Cell 4 for Item 7, Cell 5, Cell 6.

I seem to recall that somebody else had assigned those numbers, but off the top of my head right now, I -- I don't recall. I --

Q. Most likely, that were -- those were designations that were made by the -- the investigators that went to the scene and found these cells where they found them so they would identify them later?

A. That's my understanding, yes.

Q. Okay. That's fine. All right. So Cells 1 and 2 then are what you got depicted in Figure 11 on the next page?

A. Correct.
Q. And those are the two cells that appear to be -- still be connected in -- connected together, so that these were cells that were connected in series?
A. They're connected in -- these -- Cells 1 and 2 are connected in parallel.
Q. In parallel. Okay. And then the -- so there were -- in this battery pack, there were three cells -- three sets of two cells connected in parallel that were then connected in series?
A. Yes. It's -- it's -- yes. It's a -- what we would refer to as a 3S2P pack. So you have three blocks of two cells connected to in parallel. So Cells 1 and 2 represent one block, cells 3 and 4 represent another parallel block, Cells 5 and 6, a third, and then those three blocks would be connected in series.
Q. So these two cells got ejected and were found on the floor of the office, correct?
A. Yes.
Q. And the picture on the bottom

right of Figure 11 appears to have some material that is fused onto the -- the cells, and is that -- do you assume that to be the -- the shrink-wrap, as you called it, covering that was originally on these cells?

A. Yes.

Q. Okay. So these cells were protected to some extent by a plastic shrink-wrap that was around them, and then they were inside the battery pack, and then they were inside the computer?

A. Yes. They would of had a, you know, the shrink-wrap wrapper on -- on the cell and that would have been -- those cells would have been in this computer, yes.

Q. So they were -- they were in the shrink-wrap and then they were in a -- in a hard plastic case, and then they were enclosed inside the computer from the bottom, right?

A. From the bottom?

Q. You insert the -- you insert the battery pack from the bottom, you don't insert it from the top -- from the -- from the keyboard surface, you insert it from

below the bottom of the computer, right?
A. Well, yeah. I mean, I'm not sure exactly where the cells float within the -- in the thickness, but the battery pack itself, does go -- go, you know --
Q. It's the wrong term --
A. -- bottom of the computer.
Q. The battery is installed from beneath?
A. Yes.
Q. So above the battery compartment area is the surface of the laptop where the keyboard is?
A. Correct.
Q. Okay. So radiant heat to get through to the battery cells themselves, would have to go through the surface of the computer that is the -- the keyboard surface first? First -- first, it'd have to go through that, right?
A. Well, the radiant heat doesn't go through that. The radiant heat heats up the surface and then the -- the conduction is going to --
Q. Okay.

A. -- going to go from there. The radiant heat is only going to be line of sight.

Q. Okay.

A. So -- so --

Q. Right. I got it. Let me rephrase it. The radiant heat would hit the top of the -- the surface of the laptop on the keyboard side. It would heat the -- the plastic or metal, whatever that is, and that heat then would be transferred to the hard plastic case of the battery pack, and then that would get hot and that would transfer its heat to the shrink-wrap, and then eventually, that would transfer its heat to the battery cell, and then that would -- the steel, and then that would then transfer its heat to the internal components based upon your theory, correct?

A. That's -- that's pretty much -- you -- excellent description of how heat transfer works in that situation, yes.

Q. Okay. And so the -- the surface of the laptop then, would have to reach a temperature in excess of 200 degrees Celsius

in order to -- there's going to be some loss of heat in that -- in that, correct?

A. We would refer to that as a thermal gradient.

Q. Right. So in other words, in order to get the inside of the battery cells to 200 degrees Celsius, the surface of the computer by the keyboard would have to get a lot hotter than that in order to -- to -- with the heat loss that would occur with each transfer to each material to get the battery components up to 200 degrees Celsius?

A. Well, you're neglecting the -- the fact that once the batteries get above around 80 to 90 degrees Celsius, that they begin to generate their own heat, right?

Q. Okay.

A. So your assumption would be true if the batteries were completely discharged and could not generate their own heat, right?

Q. Okay --

A. But we've already established that there's an onset temperature that goes

from Stage 1 to Stage 2, right? I don't think anybody disputes that. The above 80 to 90 degrees Celsius-ish that the battery will begin to generate their own heat.

In fact, like the arc testing that, you know, one of these citations that I -- that I referenced is, you know, excelling rate calcimetry. That only applies heat up to the onset temperature. Beyond that, it just basically -- the batteries are in adiabatic condition and they self-heat up to that -- up to the thermal runaway temperature.

So the batteries simply needed to be heated up to 80 and 90 -- 80 to 90 degrees C and enough heat provided that the thermal -- the temperature can build up from the batteries themselves. So I just want to make sure that we're clear on that, that you don't need to get external heating up to that -- that point, that the batteries will self-heat themselves up to thermal runaway if there is no way for the batteries to dissipate that thermal energy.

Q. Okay. And I -- and thank you

for that clarification. So you're saying that -- that whatever the heat on the surface and whatever the heat loss as it goes from material to the other, once the batteries get somewhere in the 90 to 100 Celsius range, they'll start to produce their own heat internally?

A. Correct.

Q. And I believe you said previously in your testimony that the beginning of that process is -- is a slow one, and as the temperature rises, it -- it -- the -- the change in temperature per second increases until it gets to the point where it becomes very rapid after 200 degrees Celsius; is that true?

A. Well, you know, very slow versus, you know, it's as the temperature increases, the rate of temperature rise increases, right?

Q. So what is -- what is the -- the typical -- once you get to 90 to -- let's say 70 to 90 degrees Celsius, what is the rate of change of temperature from a thermal runaway that's -- reaction that starts over

the first 50 degrees, say, from -- from 100 to 150? How quickly does that happen?

A. Well, you're really doing a great job at testing my -- my -- my memory skills. I -- I -- I can't remember what, you know, off the top of my head what the degrees C per minute is -- is -- is going to be, what that temperature rise is.

Q. Do you have a range?

A. I -- I -- off the top of my head, I -- I really don't want to -- to throw numbers out, you know, that could, but, you know, all -- what I'm saying is that, you know, you initially said, well, the computer -- the top of the computer has to be hotter than the battery in order to get the battery to go into thermal runaway.

I clarified that, no, that's not the case, because once you heat the battery up to the point where the battery starts to generate its own heat, as long as the battery cannot dissipate that heat as fast as it's being generated. The battery will continue to self-heat itself up. The rate at which it does that is going to depend a

lot on how much more heat is going into how much, you know, how insulated the battery is, how much heat can be -- can come out it, all those things.

So it's -- I can't put a number on that, but I can -- I can -- but I can qualitatively say that those are things that you consider when you're looking at how fast it's going to, you know, take, you know, how long it's going to take for the battery to have a thermal event.

Q. And I think you said -- so again, I think your testimony before was, at the beginning, the generation of heat, once you get to that 70 to 900-degree temperature rage is -- is much slower than it is later in the reaction; is that a true statement?

A. As you increase the temperature, the heating -- the self-heating rate of the battery increases.

Q. Right. And I think if you read the Sorensen paper, there's a graph that shows that -- that the temperature goes up rather slowly and then it gets to 200 and then it shoots up at a tremendous rate; do

you recall that? I can show you the graph, but --
A. Well, let's -- if you're going to --
MS. WANEMAKER: Yeah.
A. -- bring it up, why don't you show it to me and just -- we're -- we're clear on -- on everything.
Q. Okay.
MS. WANEMAKER: Do you want to take a little break before we do that? It's been about an hour and 15 minutes.
THE WITNESS: Sure.
MS. WANEMAKER: Just quick to stretch legs.
THE WITNESS: Yeah.
THE VIDEOGRAPHER: The time is 2:44 p.m., and we're going off the record.
(An off-the-record discussion was held at this time.)
THE VIDEOGRAPHER: The time is 2:54 p.m., and we're back on the record.

Q. Okay. Dr. Horn, I've marked the Sorensen article, which is Tab 14 of your binder, as Exhibit 9, and that was what we were talking about. There's a graph on the second page of that article, which is Page 2 of 16, that I wanted to look at, and you said you had looked at it and we wanted to look at it together.

(Exhibit 9, Sorensen Article, was received and marked for identification by the reporter.)

A. Yes, I have it.

Q. Now, this graph has -- has -- in the X axis is temperature, and on the Y axis is rate of change of temperature; is that true?

A. Correct.

Q. And it's also a log scale, correct?

A. It is, correct.

Q. And a log scale is just a way to compress the data so that -- because if there's a great change, it's difficult to graph in -- in one graph. So you compress the scales so that you can get all the data

on one -- one chart, basically -- or you want to give -- why don't you give a better explanation of a log scale than I just did.

A. Yeah. I -- I -- a log scale is useful when -- when the change that you're measuring -- in this particular case, you're -- the -- the -- the rate -- the change in the temperature rise as a function of temperature, and you can see from the -- the plot that that occurs over, you know, you know, two to three orders of magnitude.

So if you were to do the Y axis on a linear scale, you really wouldn't be able to see much of a change, you know, at the lower temperatures, right? That -- that would -- that would -- that would be kind of compressed. So the log scale gives you -- it's -- it's almost the opposite of compression.

It kind of expands that so that you can really look at the low rate of temperature rise compared to the high rate of temperature rise over a change in the actual temperature.

Does that make sense?

Q. Yes. And thank you. That's a much better explanation than I -- than I tried to provide to you, and I don't know why I tried in the first place.

So if we take a look at Figure 1 then, which is the one we're looking at, this is -- again, we talked about this previously, but the way that Sorensen, et al. described the thermal runaway process was, there were three phases, right?

A. Three -- yeah. Three stages, yes.

Q. Stages. I -- I keep calling -- phases, they call them stages, and you're absolutely correct, they're stages. So the first stage is the relatively normally operating range of the battery?

A. It gets above -- it does kind of get above the normal operating range in the -- of the cell, but yeah. Normal operating range is going to be, you know, they want, you know, you want to be below the onset temperature, right?

So the typical normal operating range, the battery is, you know, below 65 or

below 60 degrees Celsius.

Q. Okay. And then they -- they demarcate the -- the time when the battery contents themselves start to generate heat as Phase 2?

A. Yes, they do.

Q. And they -- they indicate that, in their study anyway, that -- that battery -- that heating generating phase begins at about 117 degrees Celsius?

A. Correct, yes.

Q. And then -- then the temperature starts going up based on heat that's generated by the chemistry in the battery?

A. That's correct, yes.

Q. Now -- so using this log scale is a little confusing, so I just want you to help explain it to us. So there's a line for -- for when the rate is one degree per minute, that's across -- horizontally across the graph, right?

A. Correct.

Q. And so everything below that line then is some fraction of a degree per minute?

A. Correct.

Q. So up to the 150-degree level approximately, it looks like the rate of change with the heat generated within the -- the battery cell at Phase 2 is less than one degree per minute?

A. In -- in this type of test -- - that is -- that is correct, and, you know, keeping in mind that, you know, in these types of testing -- in this type of testing, basically, what -- what you're doing is, you are applying heat up until the cell starts to self-heat, and then you stop applying heat and you just basically let the cell heat itself up under adiabatic conditions. So --

Q. But we're -- and -- and that's being done, because you want to -- you want to try to measure the amount of heat that's actually generated by the battery contents, not by the heat that might be externally applied?

A. That -- that is correct. These -- these, you know, very, very controlled laboratory tests to, you know, extract as

much information as you can get out of what's happening inside the battery. So they -- they -- they take a long time.

Typically, accelerated rate calorimetry tests can take a day to two days to -- to perform to -- to really extract that information out that you're looking for.

Q. So getting back to my question then, up until 150 degrees, the heat that's generated by the chemistry by the battery once it gets to that first transition point, the rate or change is less than a degree per minute?

A. Correct, with -- with -- in the absence of application of additional heat, yeah. That's just the battery generating its own heat under perfect adiabatic conditions.

Q. That was the premise of the question, yes. So the answer is, yes, that's -- that's correct, and then when it gets above 150 degrees, the rate of change stays below ten until it gets to somewhere around 180 degrees.

Would you agree with that interpretation, again, with the same premise that this is the heat generated by the battery chemistry itself and not by any external additional heat?

A. Yeah. In -- in -- in this particular example, in -- for this particular cell, that -- that's what it shows, yes.

Q. So you think that this was just some unique cell that they did and this wasn't meant to in -- indicate what is generally true in thermal runaway in 18650 battery cells?

A. Qualitatively, qualitatively, this is exactly what one expects, Stage 1, Stage 2, Stage 3. Quantitatively, one would want to know exactly what chemistry was being applied -- was in the cell, exactly the state of charge, the size of the cell can -- can matter as well, the form factor, those types of things, but qualitatively, absolutely, you know, you've got Stage 1, the cell, you can heat it up.

It doesn't generate heat up

until the onset temperature when you go into Stage 2. Stage 2, the cell begins to self-heat. If it's in a perfect adiabatic environment, it will continue to self -- it will continue to heat itself up.

The rate of temperature rise will increase until you get to the thermal runaway, you know, critical temperature, at which point, the chemistry in the cell begins to react at such a rate that it's essentially unstoppable and will go to completion.

Q. Okay. So is your reference, Methodologies For Battery Failure Analysis, does that provide a different rate of temperature at these different phases than this graph does?

A. Well, yeah. I mean, you -- you -- one would -- one would want to look at an 18650 with the same chemistry at the same state of charge, because, you know, those things -- and -- and also the same energy density, right, because -- absolutely.

Those specific numbers, as far as picking a specific temperature and

picking -- and looking -- looking a particular -- a specific rise, that -- that point that you're -- that you're looking at, is going to be dependent on the cell chemistry, the state of charge of the cell, as well as the specific design of the cell as well. So, yes. I mean --

Q. So it's --

A. It -- it will be different, and that's why people do the arc testing, because if it was just, like, we -- then otherwise, we would only need to do one cell and then that would apply to everything, but that's not the case, right?

Q. So --

A. You have to look at the, you know, if you're looking at -- if you want to say, well, at 150, it's ten degrees C per minute for that cell, that's true, right? For that cell under these conditions, at that particular state of charge, that's right, right?

So it can -- it will -- it will be different for a different cell using sightly different materials, a different

cell design, a different energy density, a different state of charge, it would be different.

Q. Okay. The question I was trying to interpose while you were giving that answer was, what data or references did you utilize when you came to your opinion that once the temperature of the battery pack from the radiant heat got to 90 degrees, that what the rate of change of the inside of the battery cell was after that point?

What data did you rely upon?

A. I don't think that anywhere in my report I -- I -- I speak to that other -- other than the fact that we know that with, you know, convectional lithium ion cells, when you're above, you know, in the 80, 90 degrees C area, that the cells begin to self-heat. So --

Q. Right. But this -- this graph indicates that the rate of change up to 150 degrees is -- is less than one degree Celsius per minute.

So I'm just saying, did -- you must have looked at some other data that

indicated that the rate of -- of increase of temperature is much faster than that.

A. Why -- why -- I don't understand why you would -- you would assume that.

Q. Well, because you said that all the -- the radiant heat had to do was raise the level of temperature in the batteries to the threshold of when heat started to be generated from the batteries, and then the batteries would -- would heat themselves to the point of thermal runaway, so radiant heat didn't have to provide heat all the way up to 200 degrees Celsius; do you recall that?

A. I -- I -- we probably need to get the reporter to go back to that. I don't -- I don't think I said that specifically.

What I said was -- and just make sure that I clarify this, you had said that you need to have a temperature of the surface of the computer hotter -- that was hotter than the battery itself. I said that you were neglecting the fact in that question that the batteries are producing

their own heat.

So now, you have both the heat coming down on top of the computer, the radiant heat heating the surface of the computer, which is then heating the batteries by -- via conduction. Plus, you have the batteries heating themselves up. So now, you have an internal source of heat versus an external source of heat, and I'm sorry if I was not clear on that.

I didn't say that -- I don't believe I said -- and we can go back and take a look. I don't believe I said, you, you know, shut off the radiant heat. You could shut off the radiant heat and it's going to take a long time assuming perfect adiabatic conditions.

It will -- it's -- it's slow. Once you turn off the external heat source, which is what the arc testing does, this test, which is in this report, shuts off the external heat at the point of the onset. So at that point, the only source of heat is -- the heat from -- that's being generated internal to the battery, okay?

Keep in mind, nobody is saying that, suddenly, the computer is pulled out of the office and set on -- on the side and it's heating itself up. There is still heat coming from the radiant heat source. So this is a great study.

It shows phenomenologically what happens in -- in a 18650 cell, right -- or in fact, I don't know that this is actually an 18650, but generally, this is what happens in lithium ion cells, Stage 1, Stage 2, Stage 3. The purpose of this is to show that once you get above a certain onset temperature, the cell begins to generate its own heat.

So from the incident situation -- now, you've got two sources of heat from the battery cell perspective. You've got the heat that's being applied from the external heat source and you have the heat that's being generated from the cell.

Q. I understand that completely. That wasn't my question, but thank you for that long answer.

So the battery internal contents

have to get to 200 degrees Celsius, correct, approximately?

A. 180, 190, yeah. That -- right in there.

Q. And -- and what you're saying is that that heat to -- to cause the internal battery components to get to 200 degrees Celsius can come from two sources, the external heat, plus the heat that starts to be generated by the battery?

A. Correct.

Q. Now, what this indicates, though, is that the heat that's generated by the battery at the early part of that Phase 2, is a relatively slow generation of heat, correct?

A. At -- at the beginning of the Stage 2, it -- it -- it -- it I mean, it's -- it is a small amount of heat at the beginning of Stage 2, which is why if you --

Q. But just -- just --

A. -- why if you review the external heat source --

Q. Yes, is the answer.

A. It takes a long time -- it takes

a long time to get to that.

Q. Yes is the answer. At the beginning, the internal heat generated by the battery in thermal runaway goes relatively slowly, and in this study, it was less than a degree per minute?

A. At -- at the onset in the absence of any additional external heat source.

Q. Right. So -- so under your theory then, you have the radiant heat that's heating the computer and -- and heating the top of the computer to a certain temperature. Then as that heat is transferred downward, there's some loss and some differential between the surface temperature and the outside of the battery pack, at least, is going to occur there, correct?

There's going to be some loss of temperature of the heat source from the external source, because it's got to go through three layers of plastic?

A. Initially, until the cell --

Q. Yes. Just talking -- I'm just

talking about the external component of what's being transferred. In other words, that's all I'm asking right now. The external component that -- the source that you say from the unknown prior -- from the unknown source is what we're talking about here that was applied in radiant energy to the top of the laptop.

That component is going to be some level of degrees less than the temperature of the surface of the laptop for that component only?

MS. WANEMAKER: Object to the form.

You can answer.

A. Up until the cell hits the --

Q. Just -- just answer my question. I'm -- I'm -- we're dividing -- I'm not saying that the temperature of the cell will be that temperature. I'm talking about the contribution of heat from the -- the radiant energy that goes through the -- the three layers of plastic before it gets to the cell.

That component is going to be

less heat at the level of the cell than it was at the surface, not -- not including the internal temperature, which we're going to talk about?

A. Counselor, you're -- you're -- I'm sorry, you're not talking my language, and I --

Q. I'm sorry --

A. I got ---

Q. Let me -- that's okay, I'll just rephrase it. So let's just use numbers.

If the -- if the temperature of the surface of the laptop at the -- at the keyboard level from radiant heat reaches 200 degrees Celsius, okay, assume that that's possible. Is that 200 degrees Celsius temperature energy going to entirely be transferred to the battery cell?

A. Counselor, again, you're not talking my language. So let me -- let me -- let me -- I believe what you're saying is that there is a thermal gradient initially, because you have external heat source impinging on the surface of the computer, right? The keyboard area of the computer,

right?

We all know that there is, because there's melting on the top of the computer, fine. There's an external heat source impinging on the surface of the computer. The batteries are inside the computer. So for the batteries to heat up, heat has to get transferred from the surface of the computer to the cells.

There is going to be a thermal gradient, a temperature gradient, if you will, between the surface and -- and the -- and the cells. Initially, the cells will be cooler than the surface. That holds true up until --

Q. Okay --

A. -- onset temperature --

Q. All I wanted --

A. -- self-heat --

Q. Okay --

A. -- at that point, then it can reverse, right? The cells become -- the cells can get to a higher temperature than what is actually at the surface, because the cells are generating their own heat at that

point, right?

Q. You're getting ahead of me. Okay. So at the beginning, though, the component that's coming internally from the cells, according to Sorensen and according to what you're saying is well-known, is the rate of change of increase from the internal temperature from the battery chemistry going into thermal runaway, is a slow gradient until it gets to a certain point where it starts to get to, you know, ten degrees per minute, and then eventually, it goes up to 1,000 degrees per minute once it gets into Phase 3?

MS. WANEMAKER: Objection to form.

You can answer if you're able.

A. I -- I -- I can't. I -- I don't even know what the question is. I'm sorry, sir --

Q. That's okay --

A. I don't --

Q. You're doing your best to obfuscate, that's fine. What I'm trying to get at --

A. Sir -- sir -- sir -- you are -- you are mischaracterizing my testimony --
Q. Okay. Well --
A. -- and that is not -- that is not --
Q. I'm sorry --
A. I am doing my best to give you an honest and -- and technically correct answer to your question. You are asking me questions that are not the way that a technical person would ask them, all right, and I'm giving you technical answers back to you, which for whatever reason, you're not liking.
So I'm doing my best. I am not obfuscating. Let's make the record clear on that, and I --
Q. I think the record is clear on that.
A. Quite frankly, I am offended that you would say I'm trying to obfuscate.
Q. Okay. Well, I'm sorry. I didn't mean to offend you, but if you would let me ask questions and you would answer them, I promise I won't offend you anymore.

A. I am doing my best to answer you in --
Q. Okay. We'll, I'm doing my best --
A. -- correct way I can. I am not obfuscating.
Q. Okay. Doctor, the rate of increase temperature produced by the battery themselves is less than one degree per minute until approximately 150 degrees Celsius, assuming there's no additional heat produced by the external heat source, correct?
A. In that particular plot, that -- in that particular test, yes.
Q. Okay. Tell me what other data you have that would show a different rate of increase in that initial stage of thermal runaway.
Do you have a reference of another test that you're relying upon that says that in a different circumstance, that rate of change would be different?
A. Well, I would -- I would -- I guess I would probably just point to the

Larson paper, which is what Martin points to.

Q. So you would -- you would point -- again, I'm just asking you -- in other words, you didn't have the Larson paper when you came to your conclusions here as to the -- the cause of the therapy runaway here.

You assumed that it was radiant heat, and I'm just trying to get the basis of your assumption of how the radiant heat caused the cells to get to over 200 degrees Celsius.

Did you have any references other than something that was cited by the other expert that you relied upon?

A. Counselor, the surface of the computer got well-above 200 degrees Celsius, right?

Q. Okay.

A. Even if the batteries did not self-heat, that would be sufficient, because we know what the melting point is of the -- of the polymers that comprise the keyboard.

So if the polymer -- if the surface of the computer is above the -- the

thermal runaway temperature, then certainly, there is a high likelihood that the cells are going to get to the thermal runaway temperature. That is ignoring the fact that the cells are going to produce their own heat, right?

So we know that the surface of the computer got above those temperatures, we know that the cells are going to generate their own heat. It's pretty basic stuff.

Q. I have a question. Can I impose a question? You ready? Okay.

When in the course of the fire did the melting of the keyboard occur? In other words, how long after the initiation of the fire was the heat layer sufficient to melt the keyboard?

A. I, you know, I don't know -- I don't think anybody knows exactly when the fire started. All we can really point to is the fact that Ms. Marcellin observed, you know, projectiles coming out of the computer when she first walked into the -- into the office and -- and looked at the conditions.

At which point, if you look at

her declaration, the fire had already been well-underway, you know, by her observations of blackening of the -- of the armoire and -- and the walls and so, you know, I don't know exactly when it happened, but what we can say is that it certainly did happen at a -- a certain point, that the cells in the computer got hot enough to begin ejecting their contents.

Q. Okay. That's what I'm trying to get at. In other words, you were of the opinion that the temperature that caused the cells to go into thermal runaway occurred at the time that the keyboard was melting?

A. Correct, yes.

Q. Okay. And -- and what I'm asking you is, how do you know the damage to the keyboard happened at the time that Ms. Marcellin was -- was in the room -- it would have to be before she was in the room, and -- and how do you exclude that that melting of the keyboard happened at some later point after she left the house, after the fire increased in temperature, increased in -- in size and -- and the thermal layer

came down lower?

How do you -- how did you make a determination that the keyboard melted before Ms. Marcellin came into the office?

A. The fire had already -- had already begun and -- and reached to the point where there was enough smoke to activate smoke detectors on the opposite side of the house, is my understanding, and Ms. Marcellin observed projectiles coming out of the computer, which means that the cells were already engaged in a thermal event substantially after the fire had started.

Q. Okay. Well, at least one cell was engaged in a thermal event. You don't know how many were going off that she observed, did you? Did -- were you able to tell from her testimony how many cells were ejecting their contents when she observed it?

A. She said projectiles were being emitted from the computer, so that's more than one.

Q. Right. Well, you said that the

internal components can break into many pieces and be ejected; do you remember that? You called it confetti.

A. Yes.

Q. And -- and those would be super heated pieces of metal that would come out, correct?

A. I don't know what you mean by "super heated," but --

Q. They would be very high temperature and -- and probably give off photons, because of the temperature they're at so that you would see them. Just like embers give off photons.

A. Again, you know, she's said there were projectiles being, you know, from -- from the computer.

Q. Right. So from her testimony, you're able to tell that that was multiple cells going into thermal runaway that she was observing?

A. Projectiles coming from the computer.

Q. So if -- if one cell was shooting projectiles from the computer, how

would that be described differently?

A. Sir, all -- all -- that's -- that's -- that's what I said, and -- and again, you know, you don't look at any one piece of evidence or eyewitness testimony in a vacuum. You look at the entire incident, and --

Q. And so what from the entire incident allows you to provide a -- a scientific opinion that the keyboard melted before Ms. Marcellin got into the room other than your assumption that it was an external heat source that provided the -- the heat to cause thermal runaway?

Other than that fact, what other facts do you have that you could point to that says that that keyboard melted before Ms. Marcellin came into the room?

A. Well --

MS. WANEMAKER: Objection to the form.

You can answer if you're able.

A. She -- she -- she stated that -- that there was blackening of the armoire and blackening coming down from the walls, which

means there was a significant amount of radiant heat already being applied to -- to the -- to the computer, and -- and if the -- if an initiating cell ejected itself from -- then -- then -- it would not have started the fire in the computer, right? So the fire from the batteries has to be from the outside in.

Q. So you're saying that it -- when a cell goes into thermal runaway, no flames are produced from the cell?

A. When it ejects its contents, that is correct. It is far worse from a fire perspective for the cell to not eject its contents, because then the -- all of the fuel burns to completion. That's when most of the heat is -- is generated.

When it ejects its contents -- especially if it ejects its contents as we know that these did, which is basically confetti, the cell -- all those super thin foils just kind of break up into the air. There's no heat load there, there's no thermal load there.

So it doesn't actually project,

you know, a lot of thermal mass into the room. When a cell does not eject its contents, that's when it is much more likely to initiate a fire, which will cascade to other cells in the pack and start other things on fire.

Q. So a cell that doesn't eject its contents and remains in place is more likely to start a fire than the cell that ejects its contents into the room and could hit a flammable object; is that what you're saying?

A. Generally speaking, that is the case, unless the cell expels its entire electrode winding intact, which is not the case in this situation.

Q. And what is the -- do you have a -- some research that you can point to that indicates what you just said, that supports that other than your expert opinion?

A. I -- I would say that's based on, you know, basic science and -- and my 25 years of doing battery failure analysis.

Q. Now, there's -- there are literally hundreds of published articles

about fires and fire risk of lithium ion battery thermal runaway, correct?

A. There are, yes.

Q. And there must be then, hundreds of articles that support what you just said?

A. You know, very few -- very few academics actually report on these very practical matters, but I don't think that there's anybody that would disagree with the idea that if you keep all of the fuel in the can to burn to completion, you are going to generate the highest temperatures at that point.

If you eject the fuel from the can and disburse it into the air, you are going to have a much less likely chance that you are going to ignite something, because the thermal load is not -- it -- it's just -- the thermal load -- any particular piece of that confetti, if you will, is -- is to -- is -- is not sufficient.

At that point, I'm going to say, you should probably talk to somebody like Tim Myers, you know, and fire cause and origin guys, and things -- and -- and those

guys.

Q. How about Mr. Gorbett, who was actually on the scene and observed all that, he would be a good person to talk to, right?

MS. WANEMAKER: Asked and answered. We've been through this many times.

Q. You can answer it.

A. I -- look, you're -- you're -- you're getting into the point where -- where we're getting out of the battery failure analysis, and the technical aspects of the battery, and how batteries fail, and what happens to batteries under different conditions, and you're getting into fire cause and origin, which I have said from the very beginning is, you know, outside of my bailiwick.

Q. Okay. I want to just share the screen for a minute. I want to just ask you to confirm something, because I didn't mark this and I apologize.

Can you see that?

A. Yes, I can.

Q. Is that the reference that you

had in your materials as the -- one of the references that you used to support your opinions?

A. It is, yes.

Q. Okay. I just wanted to confirm that, and we've marked that as Exhibit 10 and that's the Appendix H, Methodologies For Battery Failure Analysis.

(Exhibit 10, Methodologies For Battery Failure Analysis, was received and marked for identification by the reporter.)

And you're saying that -- that -- things in this document are supportive of your opinion that you stated today that in any thermal runaway reaction where the battery contents are expelled, it is far more likely than not that it was an external heat source that caused the thermal runaway rather than some internal overcharge, overvoltage-type situation, correct?

A. Yes.

Q. And that's in this document?

A. It -- it is. I believe that there is a paragraph -- that -- that mentions that when a battery expels its contents, that it is likely from external heat source.
Q. Okay. And is it to say it's likely or it's -- I think you said in the vast majority of circumstances, it has to be from external heat; do you recall which one it was?
A. Counselor, you've got the document here. Let's go to the paragraph and we can see what it reads.
Q. Do you know where that paragraph is?
A. I don't --
Q. Say --
A. I don't recall off the top of my head, Counselor.
Q. It's a 35-page document, that's why I think it will take quite a while to find it, but we'll find it and if it's -- if it's there, I'll be able to read it later, and if not, we can deal with it on the motion.

Now, you said that you didn't look at the Matterport photographs of the -- of the rooms where the fire occurred?

A. Yes. That's -- that's what I said.

Q. And did you look at Mr. Karasinski's rebuttal report, where he measured different markings, lines of demarcation in the -- in the office and the other parts of the building.

A. I -- I saw that he did that, yes.

Q. And did you ever do anything like that to look at how far the thermal heat layer came down to make your estimate that radiant energy from the thermal heat layer was sufficient to increase the heat of the battery pack into thermal runaway?

A. No, Counselor. I'm not a fire cause and origin person. That's beyond my -- my -- my expertise to -- to do that.

Q. Well, the fire and origin person said that you would be able to answer how you estimated the temperature of the thermal heat layer being sufficient to produce

radiant energy to put the battery pack into thermal runaway.

Are you saying that you didn't do any analysis of that aspect?

A. No, sir. I -- I -- I don't know -- no -- no, sir. That's -- that's -- I -- I'm not a fire cause and origin person. So what I can tell you is what the, you know, the minimum surface temperature that the -- the surface of the computer got to and what -- what the temperature it's going to take a cell to go into -- have a thermal event and look at the -- at the evidence of what the cells looked like after the thermal event and look at that in totality from a battery failure analysis. As far as --

Q. So --

A. As far as looking at the scene and -- and -- and -- and, you know, measuring temperatures based on damage patterns in the -- in the room and things of that nature, again, you -- that's not my bailiwick.

Q. Okay. But -- but you did say that you were able to determine the

temperature that the keyboard surface reached?

A. At a minimum based on the melting point of the -- of the plastics that composed the -- the keyboard, yes.

Q. And -- and that would be -- that would be heat that you're attributing to the thermal layer radiation, not to heat generated by the thermal runaway reaction, right?

A. Correct, because the thermal runaway would have been local to the batteries, and so, you know, you do see some melting on the bottom of the computer.

That would have been due to the -- due to the thermal events, you know, with the -- with the batteries, but, you know, from the surface, that would be, you know, my -- that would be from the -- the heat from the room from the fire itself.

Q. So I think you got a photograph, let me find it. Maybe you don't. I think you have a photo of the actual laptop that you look -- you put in your report, didn't you?

A. I can go to my report and -- and look through it, if you'd like.

Q. I've -- I've got -- not the best, but I got one. If you look at Page 15, Figure 4, there's a photograph of the laptop.

A. Correct.

Q. Now, the damage to the keyboard is -- and -- and the surface of the laptop that has the keyboard on it, is not uniform, correct?

A. I -- I -- I don't understand what --

Q. Let me -- let me rephrase it a different way.

If you look at the upper-right part of the -- above the keyboard before you get to the screen, above the battery component -- compartment on the right side, would you agree that there's significantly more plastic deformation there than there is near the touch pad?

A. Yeah -- well, what I would agree with, Counselor, is that that is where the cells ejected themselves from -- from the

computer.

So there is certainly going to be a combination of thermal damage due to the softening of the plastic, as well as mechanical damage due to the -- forced the ejection of the -- of the cells from the battery compartment.

Q. So that's what's I'm getting at. In other words, that area was damaged by not only the thermal layer, but also by the heat and mechanical energy that was created by the expulsion of the -- the cells out of the battery pack, correct?

A. Yes. If you're referring to the damage directly above the battery compartment where the battery -- where the battery cells ejected themselves, correct.

Q. So that's what I -- I wanted to sort of exclude that area, because that had multiple different components to it and just look at the rest of the -- the surface that -- that the keyboard is on, and if you exclude that area then, the rest of the surface, you believe, was damaged by radiant heat, correct?

A. That's my understanding, correct.

Q. Well, that's your opinion?

A. Yes.

Q. Okay. And -- and the question I asked you before, I just want to ask you again is, when in the course of the fire did that damage -- other than the -- the thermal runaway compartment damage, when did that damage to the keyboard that you say happened from radiant heat, when in the course of the fire did that happen?

Did it happen at the beginning of the fire, or when it got to its peak, or at some point in between?

A. You're asking questions that are outside of my -- my -- my area of expertise, sir. All -- all I can say is that, you know, we know that the, you know, the surface of the computer got -- the keyboard got to, you know, temperatures that are well-above what is required to, you know, get lithium ion cells to begin to self-heat and reach the, you know, critical temperatures for thermal runaway.

When it happened, that's a question for -- for the -- your fire cause and origin guys.

Q. So just to be clear, you can't look at the surface of the -- the computer and the keyboard, and tell me that it had that degree of fire damage or heat damage at the time that Ms. Marcellin saw the -- the ejectile -- projectiles coming out of the computer, except for your assumption that it had to have occurred before that in order to put the -- the cells into thermal runaway; is that true?

A. Yeah. The heat from the fire would have to have -- yeah, gotten the cells to the point where they were going to -- into thermal runaway and expelling their contents, yes.

Q. All right. So your -- your premise is that because these cells could only have gotten into thermal runaway by external heat, because of all the things we talked about before, then if that is a true statement, then you're saying that the keyboard would have to have been damaged to

this degree by the time the cells went into thermal runaway?

A. I don't know necessarily that it would have to have been damaged to this degree, but it would of had to have been, you know, subjected -- it would have likely been subjected to temperatures above 200 degrees Celsius, yes.

Q. But -- but that's, I guess, the question. In other words, is it because you're looking at the deformity of the keyboard that you can say that the keyboard got this way before thermal runaway or is it because of your assumption based upon your state of knowledge that it's impossible for thermal runaway to occur where you get the ejections from anything other than external heat, that therefore, it must have been that hot to -- to cause this damage to the -- the keyboard.

I'm trying to understand whether -- whether you're saying that -- you're -- you're bootstrapping your opinion of when the keyboard got deformed to when the thermal runaway occurred, because you

believe thermal runaway could only have occurred from the external heat source?

A. No. I -- I appreciate that, and you -- you do -- you do have a tendency to -- to -- to pick pieces of evidence in -- in a vacuum.

I think, you know, one of the things that we have to always remember is that if -- if indeed a particular cell ejected its contents in the room prior to there being any fire, it would have generated a substantial amount of noise.

Again, these things are like gunshots going off. Nobody reported any kind of explosion, or sound, or anything at the beginning of this event. It wasn't until the smoke detector went off. So there's no evidence.

There would have been a -- an acoustic signature, that was not observed. Also the fact that we have multiple cells that have experienced, you know, an ejection and rupture events, and we see that there is sub, you know, if -- if -- if there was not enough thermal damage to the computer that

would have caused the cells to go into thermal runaway, that would be one thing, but there clearly is.

So when you look at all of this evidence in totality, all right, it is absolutely more consistent than not, with the batteries failing from external heat source versus any kind of an internal failure of -- of the cell. So again, we want to look at all the evidence in totality, not just picking one thing at a time.

Q. I think what you just said is that when a cell goes into thermal runaway, there's a gunshot-like sound that goes off that can't be missed by anyone?

A. I didn't say that. I said, when a cell ejects its contents, to the extent where either the cell can ruptures or the crimp releases with such energy that it blasts its way through the housing of the computer, right?

That's an incredibly energetic event. It is extremely loud. Again, if you go back to the standards, the standards will

tell you that when you're doing tests -- when you -- when you anticipate that their could be an explosive event of a cell, that personal protection, including hearing protection, is required. It is very loud.

I've been -- I've done this -- these tests hundreds of times. It is like a gunshot going off in the room. It can't be missed.

Q. So if it can't be missed and these cells had that explosive experience, then where in Ms. Marcellin's testimony does she recall any explosive sound that would be consistent with your opinion that it always makes a sound like a gunshot that can't be missed?

A. You know, she didn't mention it, but nobody asked her about it, which, you know, but you can't -- it's -- it's -- it is impossible. I mean, think about it. These cells will rupture.

The steel can ruptures at pressures well-above 1,000 PSI, you know, your car tires are pumped up to around 35 PSI. We're talking about very high

pressures, very energetic explosion of contents, and it is extremely loud, and I don't think that anybody could -- would -- would dispute that, that that is --
Q. Okay.
A. -- going to be a very, very loud event.
Q. So -- so here's the question, I guess, if that loud event occurred, Ms. Marcellin didn't say anything about it, correct?
A. That -- that's correct. She -- she woke up due to the fire, the smoke detector, which would imply that the cells had not yet ruptured and expelled their contents at the point where she was woken up.
Q. And then she goes -- is in the house and goes and gets the fire extinguishers, and she witnesses thermal runaway, which you say is the expulsion of the internal contents of at least one of the cells, correct?
A. She, I believe in her declaration, which I don't have in front of

me, I believe she used the word "projectiles."

Q. Okay. But is that -- what you're saying is that at that point, that's when the loud gunshot must have gone off?

A. One -- one would be hearing noise -- loud -- loud noises from the expulsion of the contents, yes. There's no -- if -- if she has seen projectiles, there is going to be very loud noises.

Q. Right --

A. You -- you cannot rupture the -- a cell like this and not have -- and -- and have it be quiet. It's -- it's just not possible. There -- it's -- it's incredibly energetic and incredibly loud.

Q. But there's no mention in any of the statements that she gave the night of the incident, or in her deposition, or in her declaration of a loud noise or multiple loud noises.

She describes many things, but she doesn't describe that, and your explanation for that is because she wasn't asked?

A. That's the only explanation I can -- I -- I can give, because it's simply not possible for a cell to expel its contents and do it quietly.

Q. Okay. So theoretically then, there could have been a gunshot that happened before Ms. Marcellin got up that she didn't get asked about either, right?

A. Well, she said she was awoken from the fire -- the smoke detector.

Q. Right. Well, you said that -- that she wasn't asked the question. Nobody asked the question if she heard a loud noise after she woke up -- or when she woke up, and you're saying that -- that -- that proves that it couldn't have been thermal runaway that caused the fire, and yet, she never mentions ever hearing that sound that you say is inevitable later.

So I'm just trying to understand what is the absence of her recollection of a gunshot before she sees the thermal runaway more credible to you as -- as an important fact to consider than the absence of her ever saying she heard the sound that you say

is inevitable.

A. Because she would have said that she was awoken by a loud noise equivalent to a gunshot or something similar, as opposed to being woken by the smoke detector.

Q. And -- and then a loud noise that you say is sufficient to cause hearing damage if you don't have ear protection would be something that she would not bother to mention if it happened after she woke up; is that what your testimony is?

MS. WANEMAKER: Objection to the form.

A. I -- I -- I don't know why she, you know, obviously, it was a very traumatic experience for her, but what I'm saying is that if -- if -- if -- the -- if the fire was started by a -- the expulsion of the -- the energetic expulsion of an 18650 cell that blew its way through the computer and into the room, it would have made an incredibly loud sound and that's not what was reported. What was -- that's -- that's -- it just isn't.

Q. Okay. If you take a look at

Figure 13 of your report, that's on Page 21.
A. Yes.
Q. That's a close-up of that area that we were talking about just above the keyboard on the right side, where you have a -- an annotation for Cell Number 3, right?
A. Correct.
Q. So that's one of the ruptured cells that broke through the -- the plastic of the -- of the top of the computer?
A. Yes.
Q. And there appears to be significant damage to the -- the plastic covering that was above the -- the battery pack, and I believe you said that that significant damage is likely to happen in the thermal runaway event? Let me -- let me phrase that a different way.
Is the damage to that -- that area of the top of the computer a combination of what you think the radiant heat and the thermal runaway heat caused to the plastic?
A. Yeah. As -- as well -- yes, in addition to whatever mechanical forces were,

you know, you know, imparted due to the expulsion of cell contents, correct.

Q. And in -- in the photograph that -- I know it's not your photograph, I think this was -- I'm not sure whose photograph it was. It must have been Mr. Galler's photograph, I guess, because that appears to be his company's name.

It appears that the -- the keys closest to that area are more damaged than the keys that are closest to the foreground of the picture; would you agree with that?

A. No. I -- I --

Q. So you think that's uniform damage to the keyboard?

A. Yeah. I mean, there's a couple missing keys there, but that's not surprising that you -- you -- you might blow off a couple keys, you know, because of the -- the shock from the, you know, from the mechanical damage, but as far as thermal damage is concerned that -- it doesn't -- I -- I don't see much of a difference in thermal damage.

Q. Okay. Then if you look at the

picture next to it, that's the bottom of the battery compartment, correct?

A. Correct.

Q. And the bottom of the battery compartment appears to be -- have much more heat damage than the rest of the bottom of the computer, correct?

A. Correct.

Q. So is it your -- and -- and the radiant heat likely played no role in heating the bottom of the computer, correct?

A. Correct.

Q. So all of the damage to the bottom of the battery compartment cover or the battery -- actually, the battery pack probably cover that -- that is. That occurred as a result of the heat from the thermal runaway?

A. Yes. Likely from Cells 3 and 4, yes.

Q. Okay. Now, I think you said that when the cells were ejected that they didn't have enough heat to melt the carpet or anything else, correct? I'll -- I'll take this off the share too, I apologize.

Remember that testimony?

A. When the cell ejects the contents, the cell can no longer have -- there's no longer a source of heat. So generally, when a cell ejects its contents, the can will not get nearly as hot as it will if the cell does not eject its contents, all things being equal.

Q. Okay. And I think it's under your nomenclature or whoever numbered the cells, it's Cell 5 and Cell 6 that ejected their content and went across the room, right?

A. Yes. Cells 5 and 6 are the -- the cells ejected -- had a crimp release and ejected their contents into the room, yes.

Q. And I think you said that if the -- those cell cans were hot, that they would have melted the carpet and that's how you knew that they had cooled before they landed?

A. Well, that -- that's one indication, yes.

Q. Okay. So take a look at -- at Page 23 of your report, and specifically the

paragraph that you've got written there, and you say -- and this is what was referenced to Cells 5 and 6 that were ejected, and you say, no wrap or residue was observed on either Cell 5 or 6.

However, a thick green polymeric residue was observed to be melted to the Cell 6 can. The color of this substance was similar to that of a green melted handle to a bag recovered from the same area of the office as shown on Figure 17, which is another photograph of a green handle of a bag of some sort; you see that?

A. Yes.

Q. And so what you're saying there is that the cell landed on that bag and melted that material and that fixed to the -- to the cell?

A. Correct.

Q. And that was the cell that had cooled to the point that it wasn't capable of melting the carpet, is that the same cell?

A. Hold on, just a second. I want to make -- what -- there was a -- you had

showed me a photo, and I don't recall which one it was, where you had said that -- you showed me a photo of a cell on carpet, and you said that there was char marks on the upper-left corner on the opening of the cell, and you asked if that had come from that cell, and I said that I -- and I said, no, because there was no evidence of the melting of the carpet on that cell.

Can we go back to that?

Q. Sure. But I -- I think -- and we will. I promise, but -- but I just want to get clarification --

A. I don't -- I'm sorry --

Q. First let me ask my question and then we'll go back. I promise we'll go back. We're on this page now and I -- I want to -- both Cells 5 and 6 ejected their content, right?

A. Yes.

Q. So it really doesn't matter -- there's only two cells that ejected their content, 5 and 6?

A. That were found outside the computer, yes.

Q. Right. And so -- so the -- the cell that we looked at on the carpet had to be one of those two?
A. Correct.
Q. Okay. So your testimony was that by the time that cell landed, it was not hot enough to melt anything, and yet, one of the two cells that was ejected -- that had ejected their contents was hot enough to melt this plastic bag handle that you've identified and actually made a picture of, of Figure 17, showing that it had sufficient heat at least to do that?
A. Well --
MS. WANEMAKER: Object to the form.
A. Yeah. That cell -- I mean, again, sir -- sir, you ask me -- you ask me specific questions of a specific photo and a specific black mark on the carpet, and you said, doesn't that -- and we can go back and -- and replay the testimony, but -- but -- and the questions.
You said, doesn't that prove that that cell caused that char on that

carpet, and I said, no, it does not in that photo for that cell. Obviously --

Q. What was the -- what was the difference in -- in the rate of cooling of the two cells that ejected all their contents, such that one wasn't sufficient to char the carpet, but the other one was sufficient to melt the handle of the bag?

A. Sir, I, you know, there -- there -- there could be a number of explanations. One could be that the -- that the -- that the initiating cell, the first cell to go off -- because it was -- it's welded and attached to the -- its -- its -- its sister cell, which is in parallel to it, carried them both out, and then at some point, shortly after that, the other cell had a thermal event, and it could have actually had a thermal event after it was ejected from the -- from the battery pack, you know, it's, you know, but again, I want to focus on the point that you asked me specific questions of a specific photo and I gave you answers to that.

Now, we're looking at a

different cell in a different photo, and yeah. I -- clearly, that cell -- that cell can was hot enough to melt that plastic when it came in contact with it.

Q. That's what I was -- I was -- okay. So let's take care of your issue.

Turn to Tab 12 and Page 15 and Figure 21, and that was the picture of the carpet with the -- what you say is not char from the cell?

A. Right.

Q. That's the one. And I believe your testimony was that it couldn't be charred, because by the time the cell reached the ground from the computer, it would not be hot enough to melt the carpet, and if it was that hot, there would be some evidence of carpet melt on the cell?

A. Correct.

Q. But that's what you said. All right. So then we're looking at your report, and the other cell that ejected its content was apparently hot enough to melt the substance that you show in Figure 17?

A. Yeah -- yes.

Q. And I think now you're saying that it's possible that the cell that melted the -- the bag handle in Figure 17 may have ejected its contents after it left the computer?

A. It's -- it's possible, yes.

Q. Okay. What is the support that you have for that occurring? In other words, is there any physical evidence of that?

A. Sir, you're --

Q. I'm just asking. Is there any physical evidence of that happening?

A. You're -- you were asking me to explain why one cell may have been -- one cell can may have been hot enough to melt polymer. Whereas, the other cell can was not. There could be a couple different explanations.

One, the polymer that one cell was in contact with had a lower melting point than the other cell. Another explanation is that they -- and, you know, ejected their contents at different points during the fire, right? So one cell may

have, you know, ejected its contents while it was in the computer carrying the other cell out, which then, you know, ejected its contents, you know, shortly thereafter and still -- and still contained, you know, a significant heat load to be able to melt the, you know, melt the polymer.
Q. Could you turn to Page 34 of your report?
A. Got it.
Q. This is in your "Timing of Events" section, and you say, in my experience, thermal runaway of an 18650 battery cell completes in seconds once it has started.
Did I read that correctly?
A. Yes.
Q. All right. So let's -- let's talk about -- first of all, using the Sorensen phase discussion, are you -- are you starting your timing from when the thermal runaway reaction begins creating its own heat or are you talking about the point that it gets to around 200 degrees Celsius when you talk about it occurring in a -- in

seconds?

A. The transition from Stage 2 to Stage 1, which typically occurs above 180 degrees Celsius. It's --

Q. That -- you're saying that -- I'm sorry --

A. Yeah --

Q. Okay. Go ahead, my question --

A. The analogy I was going to give, again, is -- is -- is a match, right? So you can heat a match up from an external source, but once the match -- it -- the tip of the match actually ignites, that's kind of like the thermal runaway event, right?

So that's -- that's when the chemistry actually goes into that Stage 3 where the cathode decomposes, produces oxygen, reacts with the electrolyte, and things go very, very quickly at that point. So it's the -- it's that transition point, Stage 2 to Stage 3, where things go within -- within seconds. Typically, it's done within ten seconds after it starts.

Q. So that's what I'm getting at. Okay. So what you're saying in this

statement is, in my -- quote, in my experience, thermal runaway of an 18650 battery cell completes in seconds once it has started, and what you're saying is that's when it gets to the point from -- from the point it gets to 200 degrees Celsius, approximately, or 190 and it has the -- it starts to accelerate in its rate of heat production at a high rate?

That's what takes seconds, you're saying?

A. Correct.

Q. Not -- not from the point where the thermal runaway reaction actually begins in Phase 2, where it begins to generate its own heat?

A. Most people would not call Stage 2 thermal runaway --

Q. Okay.

A. That -- that -- that do any kind of battery failure analysis.

Q. Okay.

A. The -- the thermal runaway is generally understood at the point where we're above typically for a fully-charged

lithium ion cell above the decomposition temperature in the melting point of -- decomposition temperature of the positive of electrode cathode material at the point where it begins to release oxygen and react with the electrolyte. That's where the chemistry generates the vast amount of its heat and it happens very, very quickly.

Q. So when you say "in seconds," are we talking about five seconds, ten seconds? What's the range from that point to when all of the cell contents are expelled, time-wise?

A. Assuming that the contents of the cell stay in the cell, less -- ten seconds or less.

Q. Well, in this case, for two of them, the contents didn't stay in the cell, right? So you're saying that once they -- once it starts ejecting material from the cell, that happens -- that completes in seconds?

A. You're -- you're talking about when the cell expels its contents as per Cells 5 and 6 here, where we have a crimp

release and the cells expelled their contents into the room?

Q. Right. How -- how -- is that not what you're referring to or you're referring to something else in this sentence?

A. I -- I'm referring to a situation where the cell remains intact.

Q. Okay. But let me -- let me -- before you go on to a long explanation, the whole point you're making here is, you're trying to time when the thermal runaway reaction happened that Ms. Marcellin saw, correct?

That's what you're doing here. You're saying that if she saw the reaction, that must have been when the thermal runaway was going on, because if it happened sooner, it would have been over by the time she got in the room; do you recall that was your premise?

A. So just wait a second. Allow me to make sure that I answer your -- your question accurately. Yeah. So yes.

I mean, that -- that -- I mean,

if she saw projectiles coming from the computer, she -- she was observing cells going into thermal runaway and ejecting their contents.

Q. Okay. So that's why I asked you to look at that, because you started to tell me about what would happen if it didn't excel -- eject its contents, and that wasn't what you made the statement for.

So now, I'm going to go back to -- my question was: What is your basis of -- and range of time that you say from the beginning of expelling its contents to when all the contents are expelled, what is the range of seconds that that takes?

In other words, does it happen all at once, does it happen in parts? What is your -- what is your opinion on that and what is the basis of that opinion?

A. When you -- and when you say "expel contents," you're referring to either a crimp release or rupture of the cell?

Q. I'm referring to what you -- you have taken from Ms. Marcellin's testimony of what she observed. You -- you took her

testimony and then you said, I interpret her testimony to be X, and based upon X, that happens in seconds.

So I don't know what you're talking about. You're the one that made the statement. I'm trying to get a sense of how many seconds it would take from when -- presumably, the reason you quote Ms. Marcellin's testimony is because she saw projectiles, correct?

A. Correct.

Q. And you assume those projectiles came from Cells 5 and 6 or potentially from the other cells that were still in the -- that exploded in the computer?

A. Based on the fact that she said that projectiles were coming from the computer, the only source of projectiles coming from the computer would have been the lithium ion cells, correct.

Q. Right. But which ones?

A. I -- I -- I -- I don't know which -- which cells she observed coming, you know, projectiles coming from the computer.

Q. Okay. So there are four possibilities, right?
A. There are four possibilities, yes.
Q. Okay. And two of those possibilities remained in the computer, and two of those possibilities -- the -- the cans, at least, were found in the corner of the room?
A. They were found in the room, correct.
Q. Right. So did you assume that what she saw was from the two in the corner of the room that were the empty cans, or did you assume that when she said she saw projectiles coming from the computer, that it was battery cell contents that were from those cells that remained in the computer that were spewing their contents out through the -- the break in the can, or did you not assume either?
A. I -- I -- I did not assume either. All -- all I said -- and let me just read the report that Ms. Marcellin --
Q. Go ahead.

A. -- subsequently observed fireballs from the notebook and fire dropping from the ceiling. If this was when the cell thermal runaway events were occurring, then this would have been well after the fire had started.

So what I was -- what I was saying is that cells were going into thermal runaway after the fire had started.

Q. Right. So I'm asking you, which cells were going into thermal runaway when she walked into the room; if you know?

A. I don't know.

Q. And what is the basis of your opinion that -- that some of the cells had already gone into thermal runaway and ejected their -- their contents before she saw the cell that was ejecting its contents when she walked into the room?

How did you exclude that other cells had already ejected their contents before she watched the contents being ejected from whatever cell was ejecting when she walked into the room?

A. I -- I never offer that opinion.

Q. So it's possible then that other cells went into thermal runaway before the cell that she observed?
A. From -- from the external heat, that's possible. Yes.
Q. Okay. And if that happened, then a fire could have started from the ejectile from those prior -- withdraw that question.
So just to pin it down, in what sequence did the four cells that went into thermal runaway go into thermal runaway in your opinion?
A. I -- I don't have an opinion on -- on the sequence of events.
Q. Do you have an opinion as to whether all four went into thermal runaway simultaneously?
A. It would likely have been very, very close, because the external heat would have been heating all of the cells, you know, at a reasonably similar, you know, rate. So most likely, they -- they would have gone -- they would have gone into thermal runaway relatively quickly following

each other. The -- the four cells --
Q. Okay.
A. -- and except for the two cells that basically got ejected from the pack and did not experience a thermal event.
Q. What's the basis of your opinion that all the cells went into thermal runaway because of the external heat source as opposed to heat that was transferred from the first cell that went into thermal runaway in combination with whatever heat they were getting from the internal source?
A. Well, again, if it was an internal cell fault --
Q. I'm just -- I'm not even talking about the -- I'm not even going there. I'm saying that -- I believe you just said that all four of the -- the battery cells experience the same -- well, actually, all six of the battery cells experience the same external thermal heat, correct?
A. Similar, yes. They would have all been in the computer at the same time, yes.
Q. And two of them show no signs of

thermal runaway?

A. They -- they did not. They were ejected from the pack, yes.

Q. Okay. And when did that happen in the sequence of events?

A. Before they reached the -- the temperature for thermal runaway of those cells.

Q. I know. But did it -- did it happen before the other cells went into thermal runaway or between when some cells went in and some weren't? When did it happen?

A. Well, they would of had to have been ejected after the -- at least the first cell had, you know, ejected its contents, right, because they wouldn't have been ejected before that -- they would -- they would not have been ejected from the computer before the -- another -- the first cell went into thermal runaway, right?

Something had to eject those cells from the computer in the first place. So clearly, they got ejected after -- at least the first cell or two cells had their

ejection of contents and -- in the battery pack.
Q. Okay. And so the force that -- that ejected them had to come from an explosion from one of the other cells?
A. It -- yes, yes. Again, you know, I don't necessarily like the word "explosion," but yes.
Q. Okay. We'll -- we'll use a different word. Something --
A. A forceable expulsion of the internal contents of -- of one of the other cells pushed those out of the pack.
Q. And not only pushed them out of the pack, but pushed them completely out of the computer, right?
A. Correct, yes.
Q. Okay. And -- and you don't know whether that happened based on one cell going into thermal runaway or multiple cells going into thermal runaway. You just know that at least one went into thermal runaway that would produce enough energy to shoot those out -- out of the computer?
A. Correct.

Q. Okay. And you can't tell me the sequence that the four that went into thermal runaway, like, which one started and which one was the last one?

A. I -- I -- I cannot.

Q. And you can't tell me over what period of time it took from when the first one went into thermal runaway that the last of the four went into thermal runaway? You can't tell me that period of time?

A. I -- I -- I can't, but what -- what I would say is that it was probably -- when a -- a multicell battery pack is -- is forced into thermal runaway through external heat, typically, from the time that the first cell goes to the last cell goes, is within less than a minute, because the cells are almost already at relatively high temperature.

So the progression goes much faster than it would if the cells at room -- if the pack's at room temperature and you have a cell that initiates the event in a vent through internal heating without an external heat source.

That takes longer to cascade through the pack. When you have an external heat source that brings the whole pack up to temperature, where the first cell starts to go into thermal runaway, things go much faster.

Hey, if -- if -- we can keep going, but I was just going -- get a break if, you know, but -- but, Counselor, if you -- if you want to go -- end -- end a certain line of questioning, I'm happy to stay for that.

Q. Yeah. Let me just finish this line and then we'll take a break, and then we'll get a read on the -- the time.

If I understand what you said, I just want to make sure I'm clear, the reason you know that the time sequence from when the first cell to the last cell went into thermal runaway was a short time sequence, because of your opinion that this occurred as a result of external heat, and when there's an external heat source that causes it, that's the time sequence that you always see?

A. Correct.
Q. So is there anything other than your opinion that these went into external heat source, generated thermal runaway that allows you to say that it was a short time sequence other than your assumption and your opinion that it always happens if that's the cause of the thermal runaway?
You understand my question?
A. No, I'm sorry. I --
Q. Okay.
MS. WANEMAKER: Can you rephrase it?
Q. Let me go back a step and just say it again.
I believe what you told me is that, you know that it was a short time sequence from when the first expulsion of contents happen to when the -- the thermal runaway reaction was over, because, you know, every time, based upon your opinion, when there's an external heat source that causes it, it's a short timeframe?
A. Correct.
Q. Okay. Other than your knowledge

of the typical timeframe when there's an external heat source, is there any other evidence, information that you can provide that would give us a timeframe of how long it -- it lasted from when the first thermal runaway reaction evidence appeared visually to when it would have been -- run its course, anything other than your assumption of how it happened that you base your opinion on that it would of happened in seconds?

A. No, no. I -- I can't think of -- as I sit here today, I can't think of any evidence that would -- that would independently be able to provide a timeline for exactly when each cell went into -- into thermal runaway.

Q. Okay. Thank you. We can take a break now, and let's go off the record first.

THE VIDEOGRAPHER: The time is 4:14 p.m., and we're going off the record.

(An off-the-record discussion was held at this time.)

THE VIDEOGRAPHER: The time is 4:25 p.m., we're back on the record.
Q. Going back to your report, Exhibit 1, Page 35, Dr. Horn.
A. Yes.
Q. The last paragraph on that page, in about the middle of that paragraph, you say, based upon my review of the scene and lab inspection data, I'm going to stop there, and that would be your review of the photographs of the scene and the reports -- the notes that you read from Mr. Gorbett and Mr. Galler, correct?
A. That's -- that's correct.
Q. Okay. Then you say, it does not appear that any cell or notebook remnants were found in the closet.
So there was nothing that you found in Mr. Gorbett's notes that discussed finding the cell remnants in the closet, is that what -- what this would indicate?
A. Well, in -- in -- in addition -- yeah, that -- that is correct. In -- in addition to the reports issued by Karasinski, as well as -- as Professor

Martin, correct.
Q. Well, the reports that were issued by Mr. Karasinski and Dr. Martin predate that date you wrote this report, correct?
A. That -- that is correct.
Q. So when you said, based upon my review of the scene and lab inspection data, you meant to include their reports as well?
A. I -- yes. I mean, basically, everything that I had reviewed, I listed in my materials of reviewed, correct.
Q. Okay. So then you say, as such, in other words, based upon the assumption that there were no battery remnants found in the closet, it appears that most, if not all, of the cell ejected was found -- ejecta, excuse me, was found in locations in the area of origin that experienced more limited thermal damage, let me just stop you there.
Are you referring then to areas of the office away from the closet?
A. Correct.
Q. Okay. So assuming that nothing

-- no ejecta got to the closet and the areas that ejecta was found that you found in reviewing Mr. Gorbett's notes and Mr. Galler's notes -- I guess it would be Mr. Gorbett's notes, because he was the one that was present, you're assuming that there was no obvious ignition pathway between the notebook cell cans -- or cell ejecta and the closet where a concentration of fuel burning was observed?

MS. WANEMAKER: Object to the form.

You can answer.

A. Yeah. I -- I -- I think it's -- again, you know, at the time, you know, writing this report, there -- there was -- I don't -- I'm not aware of anyone who had said that there was any evidence of cell ejecta in the closet. So --

Q. So -- and -- and I guess your -- your assumption here is that -- let me remove that.

You said that you're not a fire expert, right?

A. Correct.

Q. So when you say, where a concentration of fuel burning was observed, were you relying on one of the other experts who characterized what they saw in the closet or were you relying on your opinion of what you saw in the closet from the photographs that you looked at and Mr. Gorbett's notes?

A. Relying upon what -- what other experts, both Plaintiff's and -- as well as experts for HP have stated in that, I believe, it's everybody's opinion that the area of origin was in the closet. So that's -- that's essentially the basis of -- of what I'm trying to get at in -- in that paragraph.

Q. Did you -- did you find any -- any opinions of anyone that said the fire started someplace other than the closet?

A. Not that I recall.

Q. Okay. Was there anything in Mr. Gorbett's notes that suggested the fire came from someplace other than the -- the closet?

A. Not that I recall.

Q. And -- and based upon your assumption -- based upon the evidence you had at the time you wrote the report, that there was no cell ejecta in the closet.

You say at the end of that paragraph, this provides further support that the subject notebook was exposed to external heat attack as a victim of the fire. Okay.

So can you just tell me how you came to that conclusion based upon your understanding that there was no cell ejecta in the closet?

A. I -- my understanding is that the fire cause and origin experts on this case on -- on both are -- are in agreement that the area of origin is in the closet, right? So if the area of origin is in the closet and there's no evidence of cell ejecta or any part of the -- the battery from the instant computer at issue in the closet, then that is further support that the -- the battery in the laptop at the time of the incident was a victim of the fire, because it was not in the closet at the

time.

So the area of origin -- and if everybody agrees, is the closet, there's no evidence of battery material that could have ignited in the closet there, then the battery in the instant computer must, therefore, have been a victim of the fire.

Q. Is the converse of that true if there was battery material found in the closet that that would refute that assumption?

A. If there was -- I mean, you know, if there is battery material that is -- would be a competent ignition source, then that's something that I would have to review.

Q. Okay. Going onto -- to the next page, where you begin to critique Dr. Martin.

You have in the -- in the first full paragraph under Section 5.1, I think this is just a recitation of what you already said, but it says, as discussed in Section 4, analysis of the remains of the battery cells observed at the scene, the

notebook, and the association -- associated -- remnant locations in the alleged room of origin of the fire are more indicative of the subject notebook failing as a result of an external heat attack from a fire already in progress.

Did I read that correctly?

A. Yes.

Q. And I think we've been through this, so is your opinion that all those things support your theory of external heat attack, it's based on multiple things you list here, and one of them is the location of the cells -- of the -- of the -- the cans and the remnants in the room, right?

A. Yes.

Q. And is that -- is that based upon your prior testimony that -- your opinion that it's highly unlikely that if it wasn't an external heat source that caused it, there would be no ejection of the battery contents?

A. Correct.

Q. Okay. I just want to make sure I understood that, and then with regard --

when you say "the notebook," are you talking about your testimony regarding your interpretation of the deformities of the laptop itself?

MS. WANEMAKER: Objection to the form.

A. I, you know, not -- not in that particular sense. I -- I think that I'm using the -- the term in that particular sense, "subject notebook" more -- more or less referring to the subject battery in the notebook.

Q. Okay. Just so I'm clear, the sentence we're on is the one you say, as discussed in Section 4, analysis of the remains of the battery cells observed at the scene, then you say "the notebook," and I just wanted to just drill down on what you meant by "the notebook" there.

A. Yes. So the subject notebook battery pack would have been more complete.

Q. So the -- the battery pack meaning, what the -- the cells and the remnants of that?

A. Correct.

Q. And I -- I neglected to ask you this: Did you do any analysis of the capability of the battery management system of the battery pack that was in the computer at the time of the event?

A. I have -- I have not done any analysis other than to review Galler's notes and -- and -- and his report on, you know, the -- on the battery pack itself.

Q. Okay. So any conclusions or -- or any assumptions you made regarding the capability of that battery pack to provide protection against thermal runaway would be based upon Mr. Galler's assessment?

A. It -- I would say that in -- in -- yes, except for the fact that -- I mean, I did review the photos and I agree that there is no -- that there was not evidence of independent block voltage monitoring, as well as thermal monitoring of -- of the battery pack. That, you know, I -- I reviewed what he -- he did, and I was -- I agreed with that, so --

Q. So the -- the battery pack specifications from HP required a thermistor

that would monitor temperature of the battery pack, and you confronted there was no thermistor on this -- this board?

A. Based on my analysis of the photos that it did not appear that there was a thermistor in the battery pack, correct.

Q. Okay. And other than that then in -- in your observation that you made of the photographs versus -- you didn't do any research into the particular gas gauge that was on that board and whether or not the -- the components of that gas gauge that would be -- that would control things like cell balance, and overcharging, and undercharge, and over-temperature, you didn't do any analysis as to whether any of that was functional on that board?

A. Well, with -- with -- I would say that, you know, with the exception of the fact that I did not see any evidence of individual block voltage monitoring, which would be required if you were going to be doing things like block balancing, or, you know, individual block overcharge, overdischarge protection.

Q. Just help me understand what "individual block" means.

A. So recall that the -- we referred to this battery -- this six-cell battery pack as a 3S2P, right? So we've got, you know, three blocks of cells in series. Each block has two cells, right?

So the -- the -- each parallel block is -- is -- isn't parallel, so it's going to be at the same voltage and in order to have pack balancing or cell balancing, you have to monitor the voltage of each individual block, and there didn't appear to be evidence that that was -- that was, you know, that was being utilized on this pack.

Q. So the cell balancing feature is actually a two-cell balancing feature, where it would -- you would have a -- a -- a monitor of the voltage in each of the -- the blocks, which are two cells?

A. Of each of the blocks. Not each individual cell within a block, but with -- on each of the blocks.

Q. And what you could tell just from looking at the photos is that there

were no such voltage monitors that were apparent that would have been able to do that for this particular battery pack?
A. That's correct, I did not see that.
Q. And then in the next paragraph, you say, Dr. Martin alleges a specific failure mode of a battery pack without identifying the initiating cells. That's the first thing you say, right?
A. Yes.
Q. Were you able to identify the initiating cell that started the thermal runaway reaction?
A. Well, other than it would have -- I mean, the -- the first cell to go into thermal runaway, no.
Q. Right. I don't know what -- what initiating cell means to you, but that's what it would mean to me.
A. So -- so -- when -- so, you know, Professor Martin, you know, says that, you know, a -- a -- a -- one of the cells in the pack initiated the -- the entire event.
So generally, one would want to

identify if -- if that is his assumption, that's his theory, is that, you know, there's no fire and everything is fine in the room, and then for some reason, you know, a cell goes bad inside the computer and initiates the event.

Normally, one would have to identify the initiating cell and talk about how then the event progresses from there and show evidence that that initiating -- that that initiating -- that that cell initiated from some -- for some reason, whether it's an internal cell defect, a manufacturing problem, you know, whether it's because of, you know, lack of pack balancing, or block balancing, or, you know, whatever it is that you have -- you identified what the initiating cell is.

My point here is that Professor Martin did not identify an initiating cell.

Q. Okay. So you -- you say that that should have been done by having any mass measurements, and I assume that would mean a determination of the -- the loss of mass of a cell?

A. Loss of mass of a -- of a cell, or the collection of materials that were ejected from the cell, or it, you know, there, you know, anything that would -- I mean, there was -- there was no analysis from Professor Martin and he is the one that is asserting and he has the burden of proof to -- to, you know, to show that, you know, his -- his hypothesis that a -- a cell initiated the -- the event from the pack, but he didn't do any analysis to -- to confirm, you know, or -- or to show how the evidence supported that --

Q. Okay. I just want to -- I want to try to take this in pieces, and I know there's more -- there's more to it, but I want to ask you, again, the mass measurement question.

Tell me -- tell me what analysis could have been done on these empty cells and the ruptured cells, and the -- the pieces of battery that were -- the internal battery components that were found, what could have been done that would have been able to determine one way or the other the

initiating cell?

A. Well, I, you know, one of the things that one would do is to try to assert -- try to determine what the state of charge of the cell is, and, you know, so identifying any remnant of -- of un-reacted active materials from the cells, you know, doing x-ray diffraction on -- on --

Q. So wait, wait, wait --

A. -- material --

Q. Okay. Let me stop you there, I'm sorry. The x-rays are not going to tell you state of charge; are they or are they?

A. X-ray diffraction can give you some indication of what the state of charge is, and then also mass analysis of the cells that did not go into thermal runaway, may give you an indication of what the state of charge of those, and, you know, you can also do analysis of the remains of the active materials, and there -- there are other things that one can do to try to, you know, you know, provide you with experimental evidence of, you know, if you are thinking, you know, asserting, you know, this is due

to overcharge, or overdischarge, or whatever the -- the assertion is that would cause a cell to have a thermal event, you know, one could take, you know, give exemplar cells in attempt to overcharge them and try to replicate, you know, these -- these types of things. One could get an exemplar --

Q. Let me just stop you. If you got cells to try to replicate thermal runaway by overcharging them, how would that help you identify which cell was the initiating cell in this scenario? How would -- how would that happen?

A. Yeah. So you would -- you would attempt to replicate the, you know, the -- the -- the conditions that -- that are -- that he has asserted, which is, you know, something wrong with the battery pack management system, you know, that is not controlling overcharge or overdischarge, and show that if that is indeed, you know, the case, then -- then you would have cells rupture, or expel contents, or -- or things like that with -- with -- with this battery pack, and, you know, I mean, again, you

know, you know, Professor Martin is -- is the one that is asserting these things, and --

Q. Yeah. I'm just trying to drill down to understand how if you got another battery pack -- first of all, this was a -- a counterfeit battery pack that no one knows where it came from, so that's the first question.

How would you get an exemplar counterfeit battery pack that looks identical to this and know what state of charge to -- to put that exemplar battery pack into to do the experiment that you say would help you determine which was the initiating cell? How would you do all that?

A. Well, first, it's not a counterfeit pack. I -- we got to get the nomenclature correct.

Q. Well, I thought it -- my understanding -- maybe you have a different understanding, it said "HP" on the outside and it wasn't an HP authorized battery pack. I would -- I would call that a counterfeit, but if you say that there's some other term

for it, go ahead.

A. I don't recall it saying that it wasn't -- that the -- I mean, counterfeit is -- is one -- is -- is -- is a pack that is selling itself as a genuine HP product as opposed to an aftermarket or non-OME pack.

Q. And -- and you didn't find markings on this -- the remnants of the battery pack that indicated it was an HP battery pack, is that what you're saying, you didn't see that?

A. I -- I seem to recall there may be an HP model number, but nothing that would imply that it was a genuine HP battery pack.

Q. Okay. So for a consumer who sees an HP model number on it, is that something that you would expect them to immediately say, that can't be an HP battery pack?

MS. WANEMAKER: Object to the form.

You can answer.

A. I mean, you know, I -- it doesn't have the same markings as the pack

that came out of the -- that they're replacing, so --

Q. Right. But -- but I'm saying that, are you -- is it your expectation that a consumer would be able to discern one battery pack that says "HP" from another battery pack that says "HP" that maybe was manufactured at a different point in time and say, these labels are not identical, therefore, this must be a counterfeit?

MS. WANEMAKER: Objection to the form.

You can answer.

A. Yeah. I would -- I would think that that's -- yes, I would say --

Q. You think most people should be --

A. But I'm not -- I'm not an expert in -- in -- in that. That's a good question for Joe Sala, Dr. Sala, who is our human factors individual who is a part of this case. So --

Q. Okay.

A. It's a bit outside my --

Q. So let's -- let's get back to

the -- you're saying that -- that a mass measurement was not done, and I'm still trying to understand that. So two cells had -- had completely lost their contents and two cells were ruptured and had lost their contents.

So what would the mass measurement compare? In other words, what would you do to say, this -- this empty cell is more likely to be the initiating cell than this empty cell, because I found X? What is it that you -- you think you could find that would tell you which was the initiating battery cell?

A. Again, it isn't just one test, but --

Q. No, I know it's not. I know it's not, but you said mass measurement. So I want to take it one at a time, and then you can tell me how each of them is relevant to -- to proving that point, and this is the one we're talking about.

So it's mass measurement, how would -- how would you do a mass measurement analysis to determine which was the

initiating cell? That's the question. I know there's other tests, but this is the test you specified here.

So I just want you to explain why this test would tell you that or give you some -- some information for that.

A. So mass measurement on the cells that did not have a thermal event would give you an indication whether or not those cells actually vented or not, and that would give you an indication of how hot those cells got.

Did they get to the point where they would vent or did they not get to that point. So that's -- that's -- and -- and also a measure -- that would also give you a measurement on whether, you know, whether they vented and whether the CID activated or not.

So that's just -- again, it's just a data point in that analysis, but it's -- if you're -- if you're going to blame the battery pack, then you need to go through and you need to -- dot your I's and cross your T's and go through the entire analysis

of every -- of what -- of the evidence that you have.

Q. Okay. So what you just said then is that the mass measurement you would do is not of the cells that ruptured or that ejected all their contents, but the cells that were intact?

A. Correct.

Q. And if you studied the cells that were intact, you could also tell the likelihood that it was an external thermal attack, right? That would be something that would give you evidence of an external thermal attack by studying those cells?

A. It may, yes.

Q. And Mr. Galler was at the laboratory examination. Did he request that those cells be studied that way so he could make a determination as to whether this was an internal failure of the other cells or there was some support for your theory that it was an external heat attack?

MS. WANEMAKER: Object to the form.

You can answer.

A. Yeah. Counselor, you -- you -- you are under -- you do realize that -- that Mr. Galler was at the inspection over a year before I was involved with -- with this case, right? So I don't -- I don't know if he -- that's a question for him, right, whether he requested that or not.

Q. But the -- had an analysis like that been done, would that have provided you with more information about whether your theory is correct?

A. From my perspective, no. It would not have provided me with -- with -- with -- with additional information. If I was Professor Martin and I was the one accusing this battery pack of -- of initiating this event, then I would want to use every tool of my disposal in order to analyze everything that -- that I had, that -- that was available to me, but from my perspective, the evidence is very, very conclusive that it was external heat attack.

Q. So the -- the two intact battery cells would -- would have definitive evidence of how much heat they were exposed

to if you looked at them, correct?

A. I wouldn't necessarily say that they would have definitive evidence, but there -- there may be -- there -- there may be some information gleaned from -- from -- from that.

Q. And -- and the information that could be gleaned would be if it was an external fire attack, how much heat were these cells exposed to from that source?

A. Possibly. Again -- again, we don't want to take any -- any specific information or -- or test in a vacuum. It's just wanting to collect as -- if -- if -- if you're -- if you are accusing a battery pack of initiating a thermal event, you want to take the time to do as much as you can on the evidence that -- that you have. Especially when the evidence that has been collected is contrary to the battery pack initiating the event.

Q. So let me just ask you this question: Is it your opinion that studying the two intact battery cells would have proved more information to -- to determine

what caused the other cells to go into thermal runaway, then it would have to determine whether these cells were actually exposed to enough external heat to cause damage to the cells?

A. No. I -- I -- I -- I don't think so, but if I was the person that was blaming the cells, then I would certainly be wanting to do as much as I could.

Q. Okay. And as much as you could would be included -- would be looking at the actual cell components themselves, right, not just pictures?

A. No. From -- I, you know, again, if -- if -- if you're -- if you're attempting to blame the battery pack, then -- and you have the burden of proof on -- on that, then you need -- then -- then you need to have evidence that the battery pack actually did initiate the event.

So therefore, looking at the evidence to try to prove a hypothesis is something that one would want to -- want to do. Especially when all of the evidence is contrary to your opinion.

Q. So in your opinion then, the role of the expert -- an expert that says it was the battery pack that caused the fire or caused the thermal runaway, has to do more than the -- than the expert who says it was from an external fire attack, because the plaintiff has the burden of proof, is that where you're going with this?

MS. WANEMAKER: Object to the form.

A. All I'm saying is that -- that if -- if you're going to try -- if you have a hypothesis that -- and it's contrary to all of the existing evidence, than you have to go above and beyond to prove that hypothesis.

Q. Now, the -- the hypothesis -- the final hypothesis of the initial fire investigation from Allegany was that in fact, it was the laptop that started the fire, correct?

A. You're referring to the -- the fire department?

Q. Yes.

A. Yeah. That -- that -- that's my

understanding.
Q. Okay. So -- so Dr. Martin didn't come up with that hypothesis, the -- the initial fire investigators came up with that hypothesis, correct?
A. The initial fire investigator that is not a battery expert came up with that hypothesis, correct.
Q. And you don't know what hypothesis Mr. Gorbett came up with, do you?
A. No. Off the top of my head, I don't.
Q. Okay. Do you think you received that and you just forgot about it?
A. No. I don't think that I ever -- I ever did.
Q. You said that there was nothing in Mr. Karasinski's report, his initial report, that indicated that a fragment from the battery that was ejected from the battery ignited the combustibles in the closet; do you recall that?
A. Yes.
Q. All right. Take a look at your report, Page 38 and Section 6.1.

A. Okay.
Q. You pulled from Mr. Karasinski's first report, correct, that's what you have here?
A. Correct.
Q. I think you forgot to put the end of the quotes, but I assume it's everything after "based"?
A. I'm -- I'm -- I'm sorry, what -- what --
Q. In the heading, you have an -- an open quote before the word "based," but you don't have a -- close the quotation. I'm just saying, I'm assuming that the -- the entire part that's in bold there is a quote.
A. Yes. My -- thank you. I'm going to -- I'll -- I'll -- I'll chastise my -- the person who did the editorial on -- on that. So yes --
Q. I'm not -- I'm not --
A. It should have been -- it should have been a close quote. I --
Q. Okay. Just -- just want to -- to make sure that we're quoting it. So you

say quote -- and this is from Mr. Karasinski's initial report, based on the totality of the investigation, the cause of the fire was a failure of the HP Pavilion Notebook to include the battery pack.

This failure resulted in the ejection of hot battery material that ignited combustibles located within the room of origin to include the closet. So he actually did provide that opinion in his first -- in his first report. He just didn't provide a picture of the ejected piece that was in the closet, right?

A. He provided an opinion with no evidence to support it, correct.

Q. So -- but -- but he -- he said that it was an ejected piece of battery material in the closet that caused the fire in the first report, that's what he said.

A. That's what he said, but at the -- when he wrote that report and there was, you know, the evidence was collected and analyzed at the October 2020 inspection, there was no piece of evidence that was -- that had -- that was analyzed and identified

as being pulled from the closet.

Q. So let me just break that one down. Would there be some analysis that you would do that -- other than asking the witnesses that were there to determine where the fragment came from?

A. Well, one would start with doing a competent analysis similar to what was done on the fragments that were recovered from the office area, right?

One would expect that, you know, one would take photos with -- with scale bars, you know, and -- and do at least some kind of photo documentation of the actual evidence, not just some blurry photo of the of -- of -- of a, you know, a piece of material in the debris that was, you know, shoveled out of the closet.

I would think that that would be a great place to start. Just do -- do what you did on the other evidence. That wasn't done --

Q. Okay. Well, you don't know what was done, because you weren't there, right?

A. Counselor, there is -- there is

-- there is no documentation from that inspection that I certainly have seen that would indicate that that piece of debris that Mr. Karasinski identifies in his rebuttal report was analyzed at the 2000 -- October 2020 inspection.

Q. Okay. So that -- that's a different question, and that's what I was going to ask you. So is there some analysis that you could do in a laboratory in October that would have told you something about where that fragment was found?

A. Where the fragment was --

Q. Well, you said that the location of the fragment in the closet is the key factor, and you said that it should have been done in October at the -- at the lab investigation.

So I'm trying to say, how did you -- what was your methodology at the laboratory that would have provided additional evidence about where that fragment came from?

MS. WANEMAKER: Objection to the form.

A. Well, first and foremost, one has to identify and make sure that it actually is a fragment from a battery cell.
To my knowledge, that has not been done, and then secondly, one would have to analyze that fragment to determine that it actually came from one of the cells that, you know, one of the instant battery cells and not some other component that may have already been in the closet itself.
Q. What -- what other components were in the closet to your knowledge that could have produced that fragment?
A. My understanding is that there were other electronic components in the closet that may or may not have -- have had batteries in there. I mean, that's --
Q. Okay --
A. So --
Q. Which ones?
A. I -- I -- I don't know. There were other things in the closet.
Q. I know. But which ones were -- were devices that would of had a copper winding from an internal battery -- lithium

ion battery cell?

A. Nobody has identified that as being a copper winding from a lithium ion battery cell, number one. That's -- that's --

Q. That's in your opinion, I guess. Okay. Let's move on.

A. It's not just my opinion. I have not seen anything -- I have not seen anything, you know, correct -- it's not in Karasinski's report. A blurried [sic] picture of a piece of fragment on -- on -- on -- in a bunch of debris on the floor, does not say that that is a piece of copper winding from a lithium ion battery, and it certainly does not say that it is a piece of copper winding from a battery that was from the instant computer.

Q. Okay. You've -- you've made your point, thank you. All right. Then you have -- then the last sentence, you say, it appears that in the absence of a -- of a -- of an observed ignition source that would be consistent with the fire damage patterns observed in the room, Mr. Karasinski has

attributed the initiation of the fire to the notebook without sufficient evidentiary proof to support that claim; do you see that?

A. Yes.

Q. So if I understand what you're saying, because you don't think a fragment from a battery cell was found in the closet, you think Mr. Karasinski has not supported his theory of the ignition of the -- the clothing and linens in the closet, he has not supported that -- that theory, is that what you're saying here?

A. Yes.

Q. And if he had found a cell fragment that you believe was actually from the -- one of the battery cells, then that would be proof, but he hasn't found that?

A. No. I'm not saying that it would be proof, because we still have all of the evidence of the damage patterns of the batteries that are inconsistent with an internal fault in a battery as described by Professor Martin. So there's all the other body of evidence in addition to that.

Again, this is just pointing out that you have -- you have an area of origin in the closet that -- that the fire investigators continue to point to with no competent ignition source.

Now, I will defer to the fire cause and origin guys on -- on that, but from my perspective, you know, there -- there has not been -- has not been shown that there is any evidence of battery debris from the instant computer in the closet. That has not been shown.

Q. But if it had been shown, that wouldn't convince you that it was from the laptop anyway, correct?

MS. WANEMAKER: Form.

You can answer if you can.

A. Well, first and foremost, you -- one would have to show that the debris is from a lithium ion cell.

Q. Okay. So assume that -- that that was shown, that that was debris from a lithium ion cell, then that wouldn't change your opinion either, because you believe that the only way that ejected material can

come out of a battery cell is from external heat source.

So that would be just an incidental finding to you even if it weren't true?

MS. WANEMAKER: Form.

You can answer.

A. Correct.

Q. Okay. And -- and that opinion is -- is basically uninformed by any information you have as to what could have possibly started a fire that provided the external heat source, correct?

A. Yeah. I -- I -- I -- I think -- I want to make sure that -- what you're saying is that I do not personally have a -- a -- an alternative -- an alternative ignition source in the closet. Is that -- is that what you're asking?

Q. I'm asking that, either in the closet or anywhere else in the house.

A. Yeah. Then -- then I -- I believe that I answered in the affirmative in that I do not have an alterative for the -- for the initiation of the -- the event.

Q. But for your theory to be true, your opinion to be accurate, there would have to be an external heat source that was capable of heating the -- the computer before the cells went into thermal runaway?

A. Correct. Another way of saying it is, something started the fire and that has not been, to my knowledge, identified.

Q. So without something starting a fire, your theory couldn't be true? In other words, the cells didn't go into thermal runaway by themselves, they were forced into thermal runaway in your view by an external fire that caused them to heat up, right?

A. Correct.

Q. So if your theory is true, then there must be some evidence of an external fire starting somewhere else that one of the other experts has found?

MS. WANEMAKER: Objection to the form.

A. I -- I -- again, you're -- you're -- you're -- we're -- we're straying into fire cause and origin areas, right? My

understanding of an FP921 is that there are situations where the cause of a fire is undetermined, and simply by eliminating other sources of a fire if you do not have evidence that something caused the fire, that you can -- that the fire is still undetermined.

So there are situations where the cause of the fire is undetermined. So, but again, you know, fire cause and origin question.

MR. SCHWARZ: Can we just take a short break? I think I'm done. About five minutes.

MS. WANEMAKER: Sounds good.

THE VIDEOGRAPHER: The time is 5:08 p.m., and we're going off the record.

(An off-the-record discussion was held at this time.)

THE VIDEOGRAPHER: The time is 5:12 p.m., and we're back on the record.

Q. Dr. Horn, I'd -- I'd love to keep talking to you for the rest of the

afternoon until my seven hours is up, but I think I'm going to let us all have a break and we'll be done. Thank you for your patience with me.

A. Thank you, sir. Thank you for your patience with me, I appreciate it.

MS. WANEMAKER: Nice to see everyone.

THE VIDEOGRAPHER: The time is 5:12 p.m., and we're going off the record.

(Exhibit 7, Karasinski's Report, was received and marked for identification by the reporter.)

(Exhibit 8, Liu Article, was received and marked for identification by the reporter.)

(Deposition concluded at 5:12 p.m.)

WITNESS CERTIFICATION

I have read the foregoing transcript of my testimony and find it to be true and accurate to the best of my knowledge and belief.

____

QUINN HORN

Subscribed and sworn to before me on this _____ day of ________ 2025.

____

NOTARY PUBLIC

I N D E X

WITNESS:	DIRECT	CROSS	REDIRECT	RECROSS
QUINN HORN				
By Mr. Schwarz	5			

E X H I B I T S

NUMBER	DESCRIPTION	PAGE
Exhibit 1	Report	7
Exhibit 2	Yuan Article	107
Exhibit 3	Texas Instruments Application Report	114
Exhibit 4	Tab 7	133
Exhibit 5	Fire Department Report	157
Exhibit 6	Mr. Litzinger's Report	192
Exhibit 7	Karasinski's Report	342
Exhibit 8	Liu Article	342
Exhibit 9	Sorensen Article	229
Exhibit 10	Methodologies For Battery Failure Analysis	260

INFORMATION AND/OR DOCUMENTS REQUESTED
(none)

QUESTIONS MARKED FOR RULINGS
(none)

(Exhibit(s) attached)

C E R T I F I C A T E

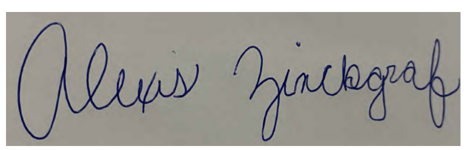
STATE OF NEW YORK)
: SS.:
COUNTY OF NEW YORK)

I, ALEXIS ZINCKGRAF, a Court Reporter and Notary Public, do hereby certify:

That the witness whose examination is hereinbefore set forth was duly sworn and that such examination is a true record of the testimony given by that witness.

I further certify that I am not related to any of the parties to this action by blood or by marriage and that I am in no way interested in the outcome of this matter.

IN WITNESS WHEREOF, I have hereunto set my hand this 27th day of April 2025.



ALEXIS N. ZINCKGRAF

Jaclyn Wanemaker, Esq., Smith Sovik Kendrick & Sugent
wanemaker@smithsovik.com

05/05/2025

RE: Marcellin, Carol v. HP, Inc. And Staples, Inc.
4/3/2025, Quinn Horn (#7232381)

The above-referenced transcript is available for review.

Within the applicable timeframe, the witness should read the testimony to verify its accuracy. If there are any changes, the witness should note those with the reason, on the attached Errata Sheet.

The witness should sign the Acknowledgment of Deponent and Errata and return to the deposing attorney. Copies should be sent to all counsel, and to Veritext at (p1steno@veritext.com).

Return completed errata within 30 days from receipt of testimony.

If the witness fails to do so within the time allotted, the transcript may be used as if signed.

Yours,

Veritext Legal Solutions

Marcellin, Carol v. HP, Inc. And Staples, Inc.
Quinn Horn (#7232381)

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